INSTRUCTION MANUAL

Type 1558-BP
Octave Band
Noise Analyzer

(Types 1560-P21B, -P23, -P24 Control Boxes)

GENERAL RADIO

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PARTS LISTS AND DIAGRAMS

This instrument is capable of making sound-level measurements required under Part 1910.95 "Occupational Noise Exposure," (Dept. of Labor) of the Code of Federal Regulations, Chap. XVII of Title 29 (36 F. R. 7006). Ref: Federal Register, Vol. 36, No. 105, May 29, 1971.

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Concord, Massachusetts, U.S.A. 01742
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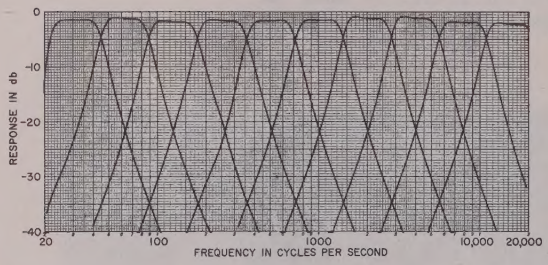
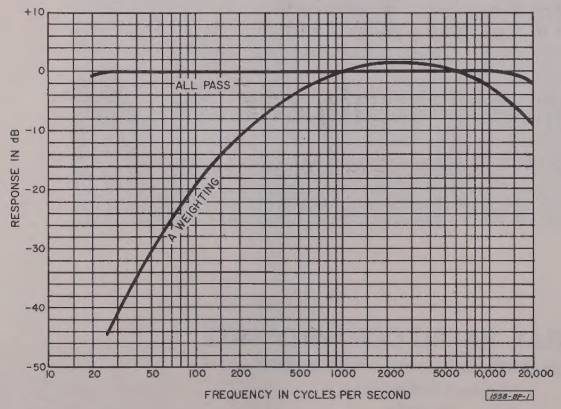
SPECIFICATIONS

Bands:

LOWER CUTOFF FREQUENCY (cps)	UPPER CUTOFF FREQUENCY (cps)	CENTER FREQUENCY* (cps)
22.3	44.6	31.5
44.6	89.2	63
88.4	177	125
177	354	250
354	707	500
707	1414	1000
1414	2828	2000
2828	5656	4000
5656	11,310	8000
11,310	22,620	16,000
ALL PASS A-weighted sound level		

*Geometric mean





Typical response characteristics of GR Type 1558-BP Octave Band Noise Analyzer. Characteristics measured at OUTPUT jack with signal applied at INPUT (SLM) terminals.
(TOP) Octave-band characteristics.
(BOTTOM) All-pass and A-weighting characteristics.

SPECIFICATIONS (cont)

Filter Characteristics, signal applied at INPUT (SLM) terminals: For bands from 63 to 8000 cps, the level at the center frequency is uniform within 1 db. Maximum deviation from ALL PASS level at center frequency in any band is 1 db. For bands from 63 to 8000 cps, the response at the nominal cutoff frequency is 3.5 ± 1 db below the response at the center frequency. For all octave bands, the attenuation is at least 30 db at half the lower nominal cutoff frequency and at twice the upper nominal cutoff frequency; the attenuation is at least 50 db at one-fourth the lower nominal cutoff frequency and at four times the upper nominal cutoff frequency.

Sound-Level Range: 44 to 150 db above 2×10^{-4} μbar in any band when the Type 1560-P6 Microphone Assembly is used.

Inputs: Impedance at MIKE terminals is approximately 50 pf in parallel with 50 MΩ. It is intended for use with high-impedance transducers such as the Type 1560-P6 Microphone Assembly.

Impedance at INPUT (SLM) terminals is approximately 100 kΩ. Maximum input is 3 volts. This input is intended for connection to the output of a sound-level meter. Low terminal is grounded to the case.

Preamplifier Frequency Characteristics: Two characteristics are included: C weighting, which meets the requirements of the American Standards Association Specification S1.4-1961 (SLM); and 20 kc, an essentially flat response.

Outputs: Open-circuit output is at least 1 volt for full-scale meter deflection. Output impedance is 6000 ohms. Any load can be connected to the OUTPUT terminals.

Meter Response: FAST or SLOW meter response is selected by a panel control. The characteristics of each are as specified by the American Standards Association Specification S1.4-1961 for General Purpose Sound-Level Meters.

Internal Calibration: The gain of the analyzer can be calibrated, by means of a built-in reference, for use with a piezoelectric microphone with sensitivity between -52 and -62 db re 1 v/μbar. With this calibration, the absolute accuracy for ALL PASS levels is ensured within 1 db.

Batteries: 9.6-volt, rechargeable, nickel-cadmium batteries (Gould, Type 9.6 V/450B) provide 30 hours of operation. To recharge them, the instrument is connected to a 115-(or 230-)volt, 25- to 60-cycle line for 14 hours.

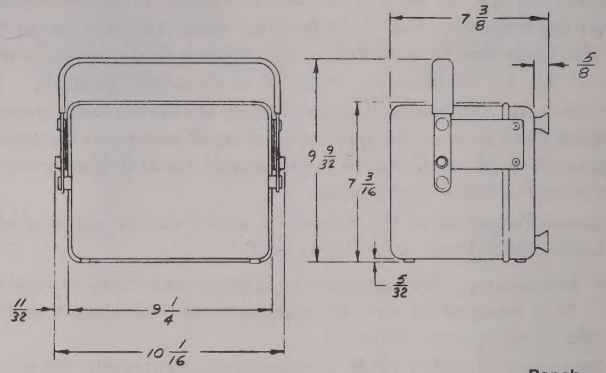
Accessories Supplied: Type 4200-0600 Power Cord, 1560-2101 Cable Assembly, 4170-7060 Carrying Strap.

Accessories Available: Type 1560-P6 Microphone Assembly; Type 1560-P34 Tripod and Extension Cable (including Type 1560-P32 Tripod and Type 1560-P73 25-foot Extension Cable); Type 0480-9762 Adaptor Set, to convert for relay-rack mounting; Types 1560-P40 and -P42 Preamplifiers and accessories.

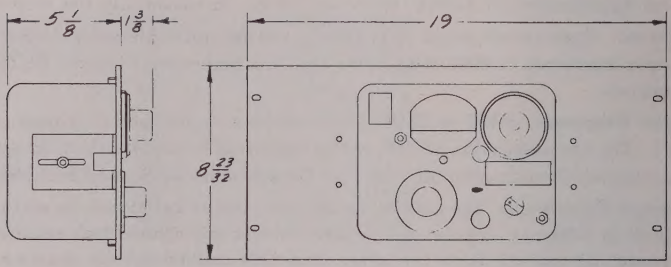
Dimensions: Flip-tilt case, width 10¼, height 9¼, depth 7¼ inches (260 by 235 by 185 mm), including handle.

Net Weight: 8¾ pounds (4 kg).

U. S. Patent Nos. 3,012,197; 2,966,257; D187,740.



Bench



Rack

DIMENSIONS IN INCHES

Handbook of Noise Measurement

This 300-page book, by Dr. A. P. G. Peterson and Ervin E. Gross, Jr., of the General Radio Engineering Staff covers thoroughly the subject of noise and vibration measurement. Copies are available from General Radio at $7.50 each, postpaid in the United States and Canada.

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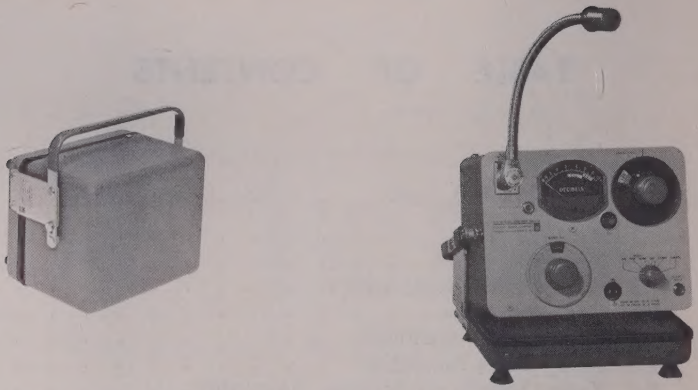
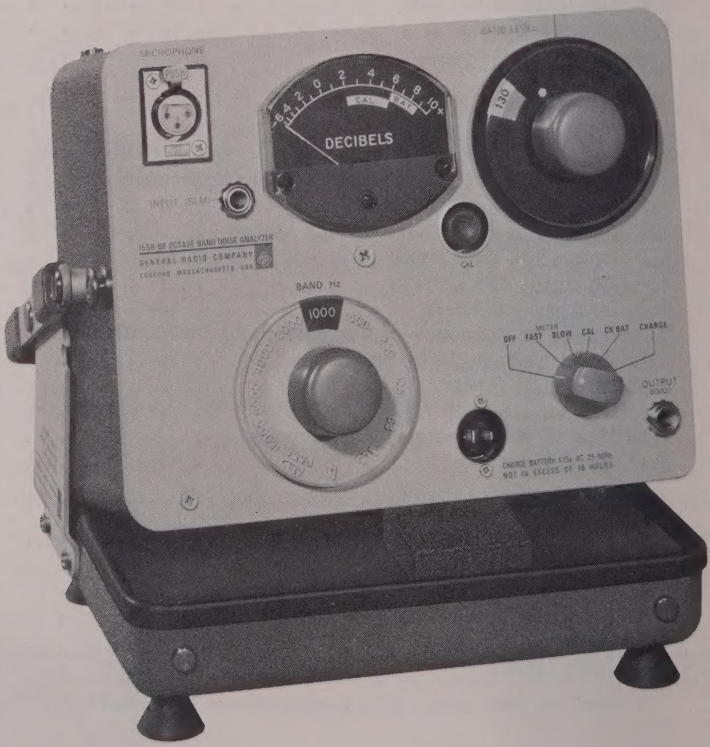


Figure 1-1. Type 1558 Octave Band Noise Analyzer.



NOTES

Throughout this manual, cycles per second (cps) and its decade multiples are used, but each is equivalent to hertz (Hz) and its decade multiples.
Example: 1 cps = 1 Hz, 1 kc/s = 1 kHz, etc.

Also, 0.0002 μbar = 20 $\mu N/m^2$.

As of October 6, 1969, the name of the American Standards Association (also USASI) has been changed to American National Standards Institute, Inc. (ANSI).

SECTION 1

INTRODUCTION

1.1 PURPOSE.

The Type 1558-BP Octave Band Noise Analyzer (Figure 1-1) is a portable audio-frequency spectrum analyzer, for use in the study of sound or vibration spectra. (For details of the various applications of this analyzer, refer to the General Radio *Handbook of Noise Measurement.*) The noise analyzer can also be used as a filter unit, a selective detector, or an analyzer for voltage spectra.

1.2 DESCRIPTION.

The analyzer consists of a high-impedance microphone preamplifier, a tunable filter with a noise bandwidth of 1 octave, an output amplifier, and a meter. When used with the Type 1560-P6 Microphone Assembly, the analyzer indicates directly the sound pressure level in any of its 12 bands, for levels between 44 and 150 db, re 2×10^{-4} μbar. The analyzer can be used with a Type 1560-P40 Preamplifier, which extends its sensitivity to 24 db and permits placement of the microphone at the end of a long cable. The analyzer can also be used with the Type 1551-C Sound-Level Meter for still greater sensitivity.

1.3 CONTROLS AND CONNECTORS.

Name	Type	Function
BAND LEVEL DB (gray knob)	6-position rotary switch	Adjusts gain of output amplifier and indicates meter range.
BAND LEVEL DB (knurled dial)	5-position rotary switch	Adjusts input level to filter and indicates meter range.
BAND CPS	12-position rotary switch	Selects band.
None (Function switch)	6-position rotary switch	Turns instrument on and OFF. Selects meter speed and mode of operation (CAL, CK BAT, or CHARGE).
CAL	Thumb-set control	Adjusts gain.
MIKE	Three-terminal Cannon Type XLR locking socket	High-impedance input.
INPUT (SLM)	Phone jack	Low-impedance (100 kΩ) input (maximum input 3 volts).
OUTPUT	Phone jack	Supplies 1 volt open circuit for full-scale meter indication (output impedance is 6000 ohms).
CHARGE BATTERY, 115 V AC 25-60C	Two-terminal male connector	Input connector for line voltage, to charge battery.

1.4 CARRYING CASE.

The analyzer is mounted in a Flip-Tilt case. The captive protective cover serves as a mounting base when the instrument is in use. The friction of the rubber seal serves to keep the instrument at any convenient angle, from horizontal to vertical.

Space is provided in the cover for the Type 1560-P6 Microphone Assembly. The flexible conduit is positioned across the panel, below the BAND CPS switch, while still held in place at the MIKE terminals.

1.5 ACCESSORIES SUPPLIED.

The following accessories are supplied with the Type 1558-BP Octave Band Noise Analyzer:

1-Power Cord, P/N 4200-0600
1-Cable Assembly, P/N 1560-2101
1-Carrying Strap, P/N 4170-7060

1.6 RELAY-RACK MOUNTING.

The Type 0480-9762 Adaptor Set, to convert the analyzer for relay-rack mounting, is available from General Radio. Complete instructions for installation are included with the set.

1.7 TYPE 1560-P6 MICROPHONE ASSEMBLY.

The Type 1560-P6 Microphone Assembly (Figure 1-2) is recommended for use with the Type 1558-BP Octave Band Noise Analyzer. It consists of a piezoelectric, ceramic microphone connected to a short length of flexible conduit, which, in turn, is mounted on a swivel base. A connector on the base mates with the three-terminal input connector (MIKE) on the panel of the analyzer.

Figure 1-2. Type 1560-P6 Microphone Assembly.

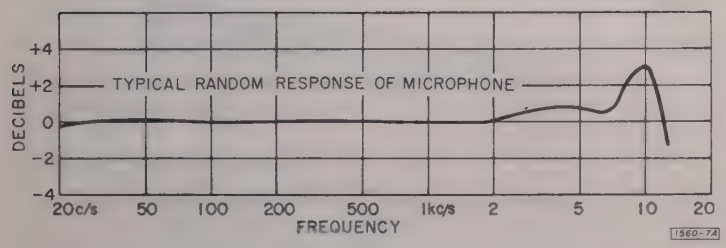


Figure 1-3. Typical random frequency response of Type 1560-P6.

1.8 TYPE 1560-P40 PREAMPLIFIER.

The Type 1560-P40 Preamplifier (Figure 1-4) is a high-input-impedance low-noise preamplifier. It is particularly well suited for amplifying the output of piezoelectric transducers, such as microphones and vibration pickups, and for driving long connecting cables without loss in signal voltage. A switch provides a voltage gain of either 1:1 or 10:1.

The amplifier is housed in a small cylindrical case. The GR Type 1560-P5 Microphone cartridge plugs directly on to the input end of the case. Adaptors are available for connecting the preamplifier to the cartridge of the GR Type 1560-P3 Microphone, to GR874 Connectors, and to 3-terminal microphone connectors. Output from the preamplifier is through a 3-terminal shielded connector. The required dc supply voltage is applied from one of these terminals to ground. This voltage can be obtained directly from the Type 1558-BP Analyzer.

1.9 TYPE 1560-P42 PREAMPLIFIER.

The 1560-P42 Preamplifier is a high-input impedance, low-noise preamplifier similar to the 1560-P40. It includes several additional features, however: a polarizing voltage for use with condenser microphones, higher output current so that longer cables can be driven, an insert voltage calibration capability for check-out convenience and a permanently-attached 10-foot cable.

It is a three-stage amplifier with a low-noise FET input stage, a class AB output stage, and full dc feedback for stability. Switched ac feedback selects X1 or X10 gain, and a self-contained oscillator supplies the polarizing voltage. This oscillator operates at a supersonic frequency to reduce interference and can be switched off when the preamplifier is used with ceramic microphones.

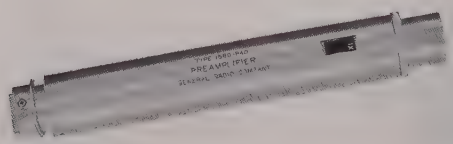


Figure 1-4. Type 1560-P40 Preamplifier.

SECTION 2

PRINCIPLES OF OPERATION

2.1 MICROPHONE PREAMPLIFIER.

The very low-level signals from a high-impedance transducer are amplified by the preamplifier to a level convenient for analysis. The preamplifier consists of an input attenuator, a unit-gain amplifier with a high input impedance, a weighting network, and a second attenuator and amplifier. An elementary schematic diagram is given in Figure 2-2.

The voltage gain of the preamplifier at mid-frequency is 20 db. An internal rotary switch can be set to give either an amplitude-frequency characteristic that is essentially flat from 20 cps to 20 kc, or one that is C weighted. The weighting switch is set in the General Radio laboratory to the 20 KC position and should normally be used in this position. Figure 2-1 shows the frequency response of the preamplifier.

2.2 FILTER CIRCUIT.

A block diagram of a single filter section is shown in Figure 2-3. The filter circuit consists of three isolated, resonant sections in cascade, with a 20-db step attenuator between the second and third sections. The sections are staggered about the center frequency of the selected band to give a maximally flat (or Butterworth) characteristic. The nominal noise bandwidth is 1 octave.

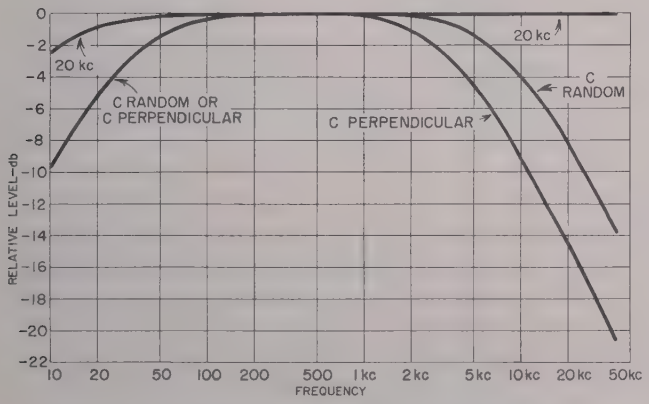


Figure 2-1. Frequency response of preamplifier.

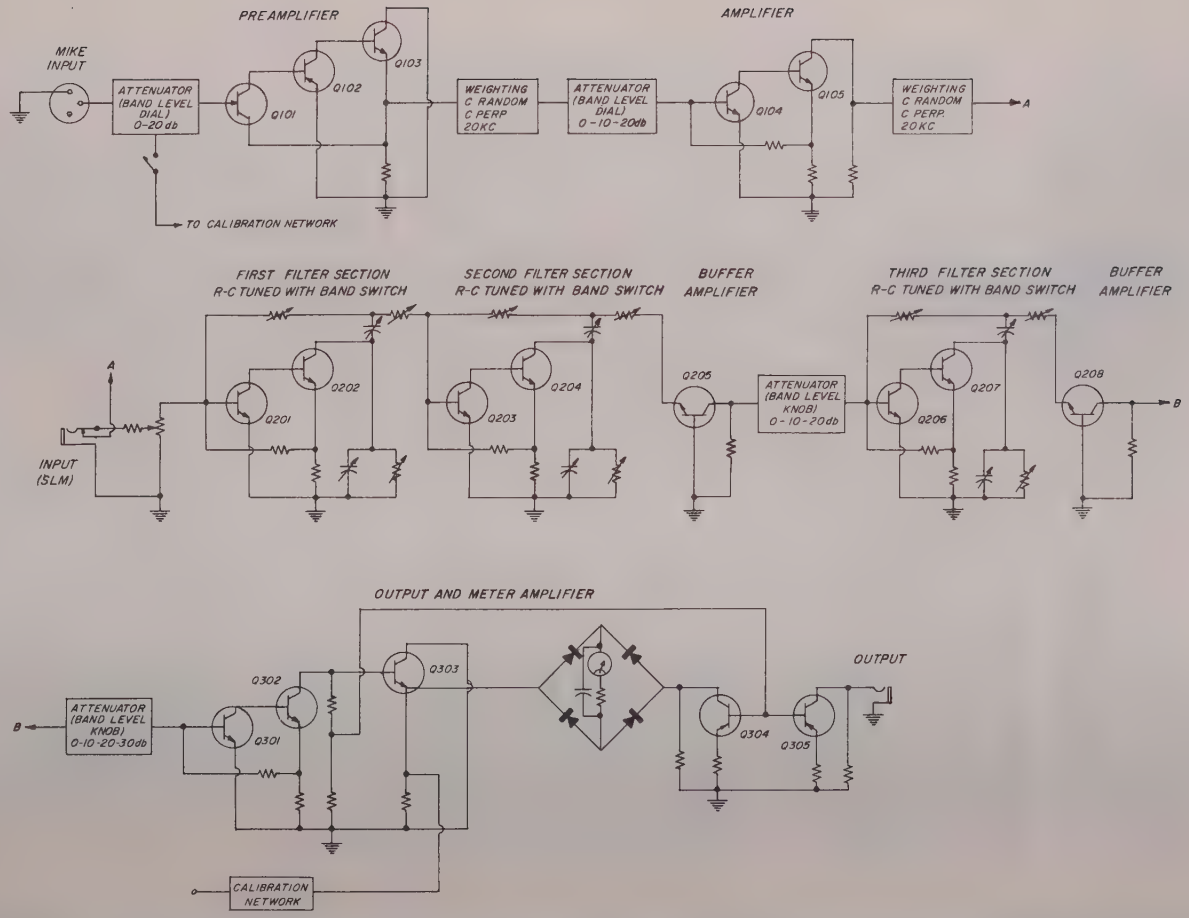


Figure 2-2. Elementary schematic diagram of the Type 1558-BP Octave Band Noise Analyzer.

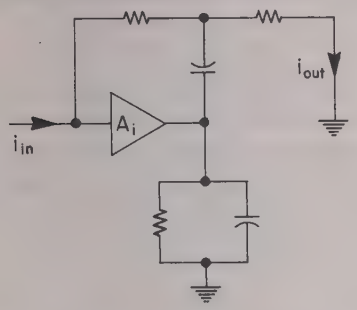


Figure 2-3. Block diagram of a single section of the filter circuit.

Each section of the filter circuit uses a highly stabilized current amplifier and an RC feedback network. To tune the filter, both resistors and capacitors are switched in a manner that allows each set of capacitors to be used for two bands.

A normalized, magnitude-frequency characteristic is shown in Figure 2-4.

This section also contains the RC circuit for an A-weighted sound-level meter characteristic.

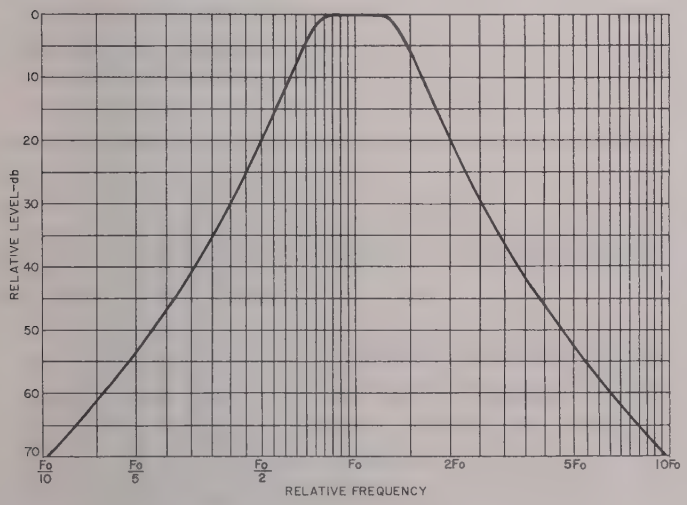


Figure 2-4. Normalized magnitude-frequency characteristic of one-octave filter.

2.3 OUTPUT CIRCUIT.

The output circuit includes a 30-db step attenuator, an amplifier, and a meter circuit. An isolating stage, feeding the OUTPUT jack, ensures that a load will not affect the meter indication.

The meter circuit gives an indication that has come to be known as quasi-rms. The conduction angle for sinusoidal excitation is chosen to give a close approximation to rms for many types of signals.

2.4 CALIBRATION CIRCUIT.

To calibrate the analyzer, the output is connected to the input through a filter, a limiter, and a calibrated attenuator. When the gain is adjusted to equal the attenuation of this feedback network, the system oscillates at a frequency of 1000 cps. The attenuation of this feedback network is adjusted by means of an internal control that is calibrated in terms of the microphone sensitivity.

2.5 CHARGE CIRCUIT.

The nickel-cadmium battery is constant-current charged through a simple half-wave rectifier and a series resistor that is connected directly to the line. When charging, the battery "floats" on the line; neither side of the line is connected to the case or to any part of the instrument except the charge circuit.

SECTION 3

OPERATING PROCEDURE

3.1 OPENING AND TILTING THE CABINET.

The directions for opening the Type 1558-BP Octave Band Noise Analyzer are given on the handle of the Flip-Tilt case. Once open, the instrument can be tilted to any convenient angle, as shown in Figure 1-1. The angle should be chosen to give the most convenient access to knobs and the best view of the panel control settings and meter indication.

The instrument can be locked fully open by the same slide pins that are used to lock it when it is closed. It can be carried in the open position, with the cover firmly in place.

The flexible conduit on the Type 1560-P6 Microphone Assembly can be positioned across the panel so that it does not interfere with the closing of the case. It can remain connected to the panel MIKE terminals.

3.2 PRELIMINARY CHECKS.

3.2.1 BATTERY. To check the battery, turn the function switch to CK BAT. The meter should read in the region marked BAT. The battery will require charging after about 30 hours of operation (refer to paragraph 3.8).

3.2.2 WEIGHTING. The internal weighting switch, S103, is set to give the preamplifier in the analyzer a flat (20 KC) frequency response and should normally be left in this position. The A-weighting characteristic is correct only when this switch is set to 20 KC.

3.3 OPERATION WITH TYPE 1560-P6 MICROPHONE ASSEMBLY.

3.3.1 CALIBRATION CHECK. Make the following check on the amplifier gain before using the analyzer. This check is valid only when the internal microphone sensitivity control is set to indicate the sensitivity of the microphone being used. Refer to paragraph 4.4.

a. Set the BAND CPS switch to ALL PASS.

b. Set the white dots on both BAND LEVEL DB controls (the large knurled dial and the small gray knob) to the red reference line.

c. Set the function switch to CAL.

The meter should now indicate in the white area marked CAL. If it does not, adjust it by means of the CAL thumbset control on the panel.

3.3.2 OPERATION.

a. Place the microphone in the desired position. Detents are provided in the panel connector to hold the gooseneck assembly in place. The connector can be turned through 180°

b. Turn both BAND LEVEL DB controls clockwise (knob and dial).

c. Set the BAND CPS switch to ALL PASS.

d. Set the function switch for the desired meter response (FAST or SLOW).

e. If the meter indicates above +10, turn the BAND LEVEL DB knurled dial until an on-scale meter reading is obtained. If the meter indicates below zero, adjust the BAND LEVEL DB gray knob until a reading in the positive section of the meter scale is obtained. The all-pass level, in db re 2×10^{-4} μbar, is the algebraic sum of the meter reading and the outer-scale BAND LEVEL DB indication.

f. Set the BAND CPS switch to any desired octave band or to A weighting and adjust the BAND LEVEL DB gray knob to obtain an on-scale reading on the meter. The level in the band selected is then the algebraic sum of the meter reading and the outer-scale BAND LEVEL DB indication.

CAUTION

Improper use of the BAND LEVEL DB controls can overload the preamplifier and introduce errors. Always measure the ALL PASS level before analyzing. Never readjust the knurled dial after selecting an octave band or A weighting. This procedure ensures that the preamplifier is not overloaded and allows the entire potential analyzing range of the instrument to be realized.

3.4 USE OF TYPE 1562 SOUND-LEVEL CALIBRATOR.

The Type 1558-BP Octave Band Noise Analyzer contains an internal calibrator that checks the electrical circuits only. For a check on the complete system calibration (including the microphone), the Type 1562 Sound-Level Calibrator is recommended. This calibrator includes a closed coupler and a driving loudspeaker that produces a known sound-pressure level at the microphone of the analyzer.

3.5 PREAMPLIFIER WEIGHTING.

The selection of one of three frequency characteristics is made by means of an internal three-position rotary switch, S103 (See Figures 4-3 and 4-6). The three switch positions are labeled 20 KC, C RANDOM, and C PERP.

The 20 KC characteristic is the most uniform and should normally be used.

The C weighting characteristics are included because it has been common practice to analyze signals that have passed through a sound-level meter set to C weighting. The C RANDOM position of the switch gives a response for the combination of the preamplifier and the Type 1560-P6 Microphone Assembly that conforms to the requirements of the American Standards Association Specification ASA S1.4-1961 (SLM), for sounds arriving at random incidence. In the C PERP position, compensation is made for the directivity of the microphone, to produce a C response with incidence perpendicular to the plane of the diaphragm. The A weighting indicated by the BAND switch is incorrect when the internal switch is set to either C position.

3.6 OPERATION WITH SOUND-LEVEL METER.

For band levels below 44 db (re 2×10^{-4} μbar), a sound-level meter, such as the GR Type 1551-C or 1561, can be used ahead of the analyzer. The procedure is as follows:

a. Set the BAND LEVEL DB knurled dial so that the indicating area is under the red reference line. Turn the BAND LEVEL DB gray knob fully clockwise.

c. Connect the output of the sound-level meter to the INPUT (SLM) jack on the analyzer, using the 1560-2101 Shielded Cable Assembly (supplied). Calibrate the sound-level meter by the means appropriate to that particular model, or use a GR Type 1562 Sound-Level Calibrator.

d. With the calibration signal applied to the sound-level meter, adjust the CAL thumbset control on the panel of the analyzer to give the same meter reading as that of the sound-level meter.

e. To analyze, set the weighting switch on the sound-level meter to 20 KC and adjust the attenuator on the sound-level meter for a meter reading between 0 and +10 db.

f. Set the BAND CPS switch to the desired band and adjust only the BAND LEVEL DB gray knob to obtain an on-scale meter reading on the analyzer. The band level in db re 2 x 10^{-4} μbar is the algebraic sum of the readings of 1) the attenuator of the sound-level meter, 2) the inner red scale of the BAND LEVEL DB dial on the analyzer, and 3) the meter reading of the analyzer.

3.7 OPERATION WITH PREAMPLIFIER.

The Type 1560-P40 or -P42 Preamplifier can be used with the analyzer to increase the sensitivity to a 24-db sound-pressure level, thus permitting operation at a remote distance from the microphone (refer to paragraph 1.8). Power for the preamplifier is supplied through terminal No. 2 of the MIKE socket of the analyzer. Plug the preamplifier and microphone combination directly into the MIKE socket, or make the connection by means of a 2-conductor shielded cable of convenient length. Compatible cables available are the 1560-9665 (4 ft), 1560-9666 (25 ft) and 1560-9667 (100 ft). Set the gain switch on the preamplifier to either X1 or X10, as desired. When it has been calibrated, the analyzer is direct reading with this gain switch set to X1. When the switch is set to X10, subtract 20 db from the indication of the analyzer to obtain the actual sound-pressure level.

When the microphone and preamplifier are used with the Type 1558-BP Analyzer, the effective sensitivity of the microphone is increased. This is because the voltage loss caused by the input-capacitance load of the preamp on the microphone is less than the loss caused by the input-capacitance load of the analyzer. Also, when a cartridge is used from a Type 1560-P6 Microphone Assembly, the loss due to the presence of the flexible arm is avoided. (The sensitivity given for a microphone is for the combination of microphone cartridge and flexible arm.)

To calibrate the analyzer-preamplifier combination, a Type 1562 Sound-Level Calibrator is recommended.

3.8 CHARGING THE BATTERY.

3.8.1 115-VOLT LINE. The analyzer is powered by a nickel-cadmium battery that provides about 30 hours of operation from full charge. To charge the battery, connect the analyzer to the 115-volt line, using the Power Cord supplied (P/N 4200-0600). Terminals for this connection are provided on the front panel and are labeled 115 V AC, 25-60 C, CHARGE BATTERY. Set the function switch to CHARGE.

3.8.2 230-VOLT LINE. To charge the battery from a 230-volt line, disconnect the lead short-circuiting resistor R508 (see Figures 4-4 and 4-7). Connect the instrument to the 230-volt line, using the 4200-0600 Power Cord (supplied). Use the 115-volt CHARGE BATTERY terminals on the front panel. Set the function switch to CHARGE and allow 16 hours to charge the battery fully.

CAUTION: Continuous or repeated overcharging may seriously reduce the battery life.

3.9 BACKGROUND NOISE.

Whenever possible, sound measurements should be made with negligible background noise. In any band, the background noise level should be at least 10 db below the total measured level for that band. When this is not possible, apply the corrections given in Figure 3-1 for errors due to background noise.

3.10 EFFECT OF PRESENCE OF OBSERVER AND INSTRUMENT CASE.

Except in reverberant fields, the presence of the observer and the instrument case can disturb the sound field and thereby introduce significant

errors.[1] To minimize this effect, adjust the gooseneck assembly so that the microphone is located as far as possible from both the observer and the instrument. The observer should stand with the analyzer in front of him and with the sound source at his side. For greatest accuracy, mount the microphone on a tripod and connect it to the analyzer by means of an extension cable. The observer and the instrument are thus removed from the sound field.

3.11 PREFERRED ANGLE OF INCIDENCE.

For sounds in reverberant fields, the angle of incidence is indeterminate.

In a free field, the response obtained with an angle of incidence of 70° with respect to the axis of the Type 1560-P6 Microphone Assembly approximates random-incidence response. The directivity characteristic of the Type 1560-P6 Microphone Assembly can be used to advantage if the microphone is positioned with its axis directed toward the source. Under this condition, a C-weighted spectrum is presented to the filter when the internal weighting switch (S103) is set to C PERP (see Figure 4-3). Do not use the A-weighting position on the BAND switch with the internal weighting switch in this position.

3.12 CARRYING STRAP

The 4170-7060 Carrying Strap (supplied) is used to support the instrument so that the operator's hands are free to manipulate the controls. Attach the strap to the thimbles at the side of the case.

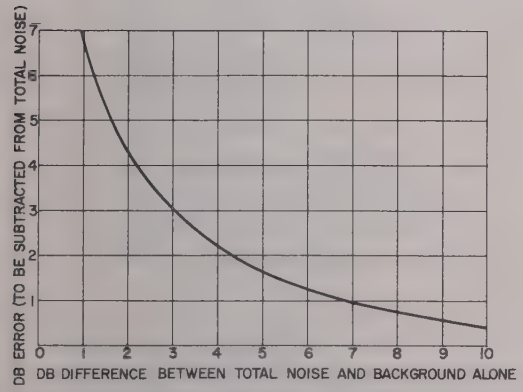


Figure 3-1. Effect of background noise on measurements.

[1] R. W. Young, "Can Accurate Measurements Be Made With a Sound-Level Meter Held in Hand?" *SOUND*, Vol. 1, No. 1, January-February, 1962, pp. 17-24.

3.13 USE AS A SOUND-LEVEL METER.

The Type 1558-BP Octave Band Noise Analyzer can be used to measure either A- or C-weighted sound levels. Except for the fact that it does not include a B-weighting characteristic, it meets all requirements of the American Standards Specification for General Purpose Sound Level Meters, ASA S1.4–1961.

To measure A-weighted sound level, set the internal weighting switch, S103, to 20 KC (it is set to this position when delivered). Then follow the procedure given in paragraph 3.3, measuring first the ALL PASS (20-kc) level, then the A-weighted level. (Use the A-weighted position as though it were an octave band.)

To measure C-weighted sound level, set the internal weighting switch to C RANDOM and proceed as in paragraph 3.3.1 and steps a through e of paragraph 3.3.2. The indicated level with the BAND switch set to ALL PASS is the C-weighted sound level.

The A-weighting position of the switch gives incorrect results when the internal switch is set to C RANDOM. (It indicates the A-weighted level of the C-weighted spectrum.)

3.14 USE OF WIDE-RANGE MICROPHONES.

The frequency response of the microphone preamplifier is essentially flat from 20 cps to 20 kc when the weighting switch is set at 20 KC. Thus it is possible to use wide-range microphones, such as those included in the GR Condenser Microphone Sets.

CONDENSER MICROPHONE SETS

CAT. NO.	DIAMETER AND RESPONSE
1560-9532	1/2-in., flat perpendicular
1560-9533	1/2-in., flat pressure
1560-9534	1/4-in.., flat perpendicular
1560-9535	1/4-in., flat pressure
1560-9536	1/8-in., flat pressure

3.15 RECORDING.

The output from the Type 1558-BP Octave Band Noise Analyzer can be used to drive the GR Type 1521-B Graphic Level Recorder, to plot amplitude versus time in a band.

SECTION 4

SERVICE AND MAINTENANCE

4.1 GENERAL.

We warrant that each new instrument manufactured and sold by us is free from defects in material and workmanship, and that, properly used, it will perform in full accordance with applicable specifications for a period of two years after original shipment. Any instrument or component that is found within the two-year period not to meet these standards after examination by our factory, Sales Engineering Office, or authorized repair agency personnel, will be repaired, or, at our option, replaced without charge, except for tubes or batteries that have given normal service.

The two-year warranty stated above attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible. If the difficulty cannot be eliminated by use of the following service instructions, please write or phone our Service Department (see rear cover), giving full information of the trouble and of steps taken to remedy it. Be sure to mention the serial and type numbers of the instrument.

Before returning an instrument to General Radio for service, please write to our Service Department or nearest Sales Engineering Office, requesting a Returned Material Tag. Use of this tag will ensure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

4.2 REMOVAL OF INSTRUMENT FROM CASE.

To take the instrument out of its Flip-tilt case, remove the four screws near the front panel, two through the top and two through the bottom of the case.

4.3 TRANSISTOR VOLTAGES.

Table 1 gives the normal voltage from each transistor terminal to ground. Allow a deviation of 10 percent from these figures. Set the panel controls as follows:

BAND LEVEL DB gray knob - - fully clockwise
BAND LEVEL DB knurled dial - - fully counterclockwise
Function switch - - FAST
BAND CPS switch - - ALL PASS

To measure these voltages, use a high-impedance voltmeter. The battery voltage must be about 21 volts.

4.4 MICROPHONE SENSITIVITY ADJUSTMENT.

The internal sensitivity control (R322) is shown in Figure 4-1. The procedure for the internal calibration, described in paragraph 3.3.1, is valid only when this control is set to indicate the sensitivity of the microphone being used. If the Type 1560-P6 Microphone Assembly is purchased, or if another type of piezoelectric microphone is used, this control must be set to the sensitivity of the microphone.

4.5 INTERNAL NOISE.

Typical noise levels at the OUTPUT terminals, for various settings of the BAND LEVEL DB and the BAND CPS switches, are given in Table 2. To measure these levels, connect a 425-pf capacitor (the equivalent impedance of the Type 1560-P6 Microphone Assembly) across the MIKE input terminals (see Figure 4-2). The capacitor and connecting leads must be shielded to avoid hum or noise interference.

4.6 GAIN CHECK.

A check on the gain gives a good indication of the serviceability of the analyzer. This check should be made at the center frequency of each band, at 400 or 1000 cps for ALL PASS, and at 1000 cps for A weighting. Apply 1 volt through a shielded, 425-pf capacitor, connected at the MIKE input terminals, as shown in Figure 4-2. Set the internal weighting switch to 20 KC and calibrate the analyzer by the method described in paragraph 3.3.1. Select the desired band and adjust the oscillator to the center frequency of that band. The center frequencies are given in the Specifications. If the instrument is operating properly, the BAND LEVEL DB indication should agree within 1 db with the values in Table 3, except on the lowest and highest bands, where the analyzer will read low by about 1 db.

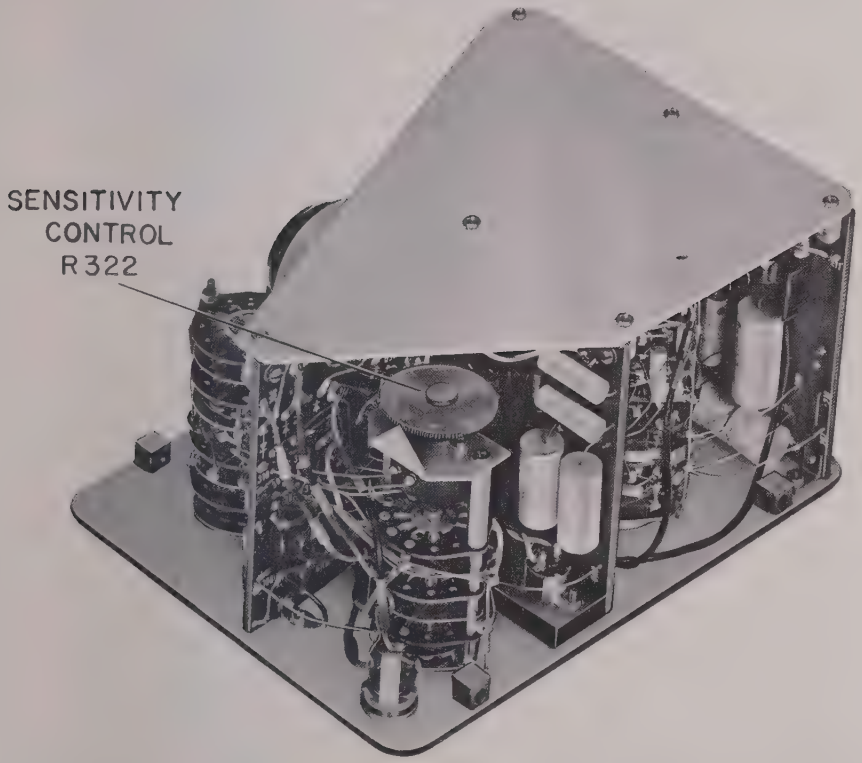


Figure 4-1. Internal sensitivity control is preset in the laboratory.

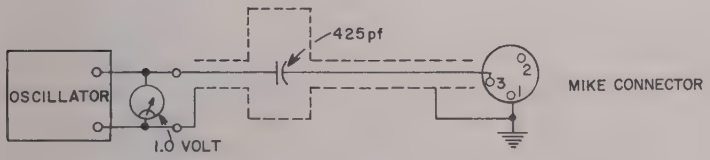


Figure 4-2. Circuit for calibration of gain of analyzer.

TABLE 1
Transistor Voltages

TRANSISTOR (Type)	TERMINAL	DC VOLTS TO GROUND
Q101	K	9.4
	G	9.3
	A	15.8
Q102	E	15.9
	B	15.8
	C	9.5
Q103	E	9.4
	B	9.5
	C	18.8
Q104	E	1.2
	B	1.3
	C	3.3
Q105	E	3.2
	B	3.3
	C	10.2
Q201	E	1.2
	B	1.3
	C	4.1
Q202	E	4.0
	B	4.1
	C	8.8
Q203	E	1.2
	B	1.3
	C	4.1

TABLE 1 (Cont)

TRANSISTOR (Type)	TERMINAL	DC VOLTS TO GROUND
Q204	E	4.0
	B	4.1
	C	8.8
Q205	E	1.2
	B	1.3
	C	9.2
Q206	E	1.0
	B	1.1
	C	3.0
Q207	E	2.9
	B	3.0
	C	8.2
Q208	E	1.2
	B	1.3
	C	9.4
Q301	E	2.2
	B	2.3
	C	5.4
Q302	E	5.3
	B	5.4
	C	11.0
Q303	E	10.9
	B	11.0
	C	18.8

TABLE 1 (Cont)

TRANSISTOR (Type)	TERMINAL	DC VOLTS TO GROUND
Q304	E	17.5
	B	17.4
	C	10.7
Q305	E	17.5
	B	17.4
	C	9.0
Q501	E	18.8
	B	18.9
	C	21.0
Q502	E	18.8
	B	18.9
	C	21.0
Q503	E	18.8
	B	18.9
	C	21.0

TABLE 2

Typical internal noise levels in db below output voltage corresponding to full-scale meter deflection.

BAND CPS SWITCH SETTING	BAND LEVEL DB SWITCH SETTING									
	140	130	120	110	100	90	80	70	60	50
31.5	68	68	68	68	67	64	54	44	34	24
63.0	68	68	68	68	67	64	54	44	34	24
125.	68	68	68	68	67	66	60	50	41	31
250.	68	68	68	68	68	66	61	52	43	33
500.	68	68	68	68	68	67	62	54	44	34
1000.	68	68	68	68	68	67	62	54	44	34
2000.	68	68	68	68	68	66	61	52	42	32
4000.	67	67	67	67	67	65	59	49	39	29
8000.	67	67	67	67	67	64	57	47	37	27
16,000.	66	66	66	66	66	63	54	44	35	25
ALL PASS	63	63	63	63	62	56	46	36	26	16

TABLE 3

Band level indications for various microphone sensitivities with 1 volt applied at MIKE terminals.

MICROPHONE SENSITIVITY (db re 1 volt/μbar)	TYPE 1558-BP BAND LEVEL DB INDICATIONS
-62	136
-61	135
-60	134
-59	133
-58	132
-57	131
-56	130
-55	129
-54	128
-53	127
-52	126

4.7 KNOB REMOVAL.

To remove the knob on a front-panel control, either to replace one that has been damaged or to replace the associated control, proceed as follows:

a. Grasp the knob firmly with the fingers, close into the panel (or the indicator dial, if applicable) and pull the knob straight, away from the panel.

CAUTION

Do not pull on the dial to remove a dial/knob assembly. Always remove the knob first.

b. Observe the position of the setscrew in the bushing, with respect to any panel markings (or at the full CCW position of a continuous control).

c. Release the setscrew with an Allen wrench and pull the bushing off the shaft.

d. Remove and retain the black nylon thrust washer, behind the dial/knob assembly, as appropriate.

NOTE

To separate the bushing from the knob, if for any reason they should be combined off the instrument, drive a machine tap a turn or two into the bushing to provide sufficient grip for easy separation.

4.8 KNOB INSTALLATION.

To install a "Snap-on" knob assembly on the control shaft:

a. Place the black nylon thrust washer over the control shaft, if appropriate.

b. Mount the bushing on the shaft, using a small slotted piece of wrapping paper as a shim for adequate panel clearance.

c. Orient the setscrew on the bushing with respect to the panel-marking index and lock the setscrew with an Allen wrench.

NOTE

Make sure that the end of the shaft does not protrude through the bushing or the knob won't seat properly.

d. Place the knob on the bushing with the retention spring opposite the setscrew.

e. Push the knob in until it bottoms and pull it slightly to check that the retention spring is seated in the groove in the bushing.

NOTE

If the retention spring in the knob comes loose, reinstall it in the interior notch with the small slit in the outer wall.

FEDERAL MANUFACTURERS CODE

From Federal Supply Code for Manufacturers Cataloging Handbook H4-1
(Name to Code) and H4-2 (Code to Name) as supplemented through June, 1967.

Code	Manufacturers Name and Address
00192	Jones Mfg. Co., Chicago, Illinois
00194	Waisco Electronics Corp., Los Angeles, Calif.
00656	Aerovox Corp., New Bedford, Mass.
01009	Alden Products Co., Brockton, Mass.
01121	Allen-Bradley, Co., Milwaukee, Wisc.
01295	Texas Instruments, Inc., Dallas, Texas
02114	Ferroxcube Corp. of America, Saugerties, N. Y. 12477
02606	Fenwal Lab. Inc., Morton Grove, Ill.
02660	Amphenol Electronics Corp., Broadview, Ill.
02768	Fastex Division of Ill. Tool Works, Des Plaines, Ill. 60016
03508	G. E. Semiconductor Products Dept., Syracuse, N. Y. 13201
03636	Grayburne, Yonkers, N. Y. 10701
03888	Pyrofilm Resistor Co., Cedar Knolls, N. J.
03911	Clairex Corp., New York, N. Y. 10001
04009	Arrow, Hart and Hegeman Electric Co., Hartford, Conn. 06106
04713	Motorola Semi-Conduct Product, Phoenix, Ariz. 85008
05170	Engineered Electronics Co., Inc., Santa Ana, Calif. 92702
05624	Barber-Colman Co., Rockford, Ill. 61101
05820	Wakefield Eng., Inc., Wakefield, Mass. 01880
07127	Eagle Signal Div. of E. W. Bliss Co., Baraboo, Wisc.
07261	Avnet Corp., Culver City, Calif. 90230
07263	Fairchild Camera and Instrument Corp., Mountain View, Calif.
07387	Birtcher Corp., No. Los Angeles, Calif.
07595	American Semiconductor Corp., Arlington Heights, Ill. 60004
07828	Bodine Corp., Bridgeport, Conn. 06605
07829	Bodine Electric Co., Chicago, Ill. 60618
07910	Continental Device Corp., Hawthorne, Calif
07983	State Labs Inc., N. Y., N. Y. 10003
07999	Amphenol Corp., Borg Inst. Div., Delavan, Wisc. 53115
08730	Vemaline Prod. Co., Franklin Lakes, N. J.
09213	General Electric Semiconductor, Buffalo, N. Y.
09408	Star-Tronics Inc., Georgetown, Mass. 01830
09821	Burgess Battery Co., Freeport, Ill.
09922	Burndy Corp., Norwalk, Conn. 06852
11236	C.P.S. of Berne, Inc., Berne, Ind. 46711
11599	Chandler Evans Corp., W. Hartford, Conn.
12498	Teledyn Inc., Crystalonics Div., Cambridge, Mass. 02140
12672	RCA Commercial Receiving Tube and Semi-conductor Div., Woodridge, N.J.
12697	Clarostat Mfg. Co. Inc., Dover, N. H. 03820
12954	Dickson Electronics Corp., Scottsdale, Ariz.
13327	Solitron Devices, Tappan, N. Y. 10983
14433	ITT Semiconductors, W. Palm Beach, Florida
14655	Cornell Dubilier Electric Co., Newark N. J.
14674	Corning Glass Works, Corning, N. Y.
14936	General Instrument Corp., Hicksville, N. Y.
15238	ITT, Semiconductor Div. of Int. T. and T, Lawrence, Mass.
15605	Cutler-Hammer Inc., Milwaukee, Wisc. 53233
16037	Spruce Pine Mica Co., Spruce Pine, N. C.
19701	Electra Mfg. Co., Independence, Kansas 67301
21335	Fafnir Bearing Co., New Briton, Conn.
24446	G. E. Schenectady, N. Y. 12305
24454	G. E., Electronic Comp., Syracuse, N. Y.
24455	G. E. (Lamp Div), Nela Park, Cleveland, Ohio
24655	General Radio Co., W. Concord, Mass 01781
26806	American Zettler Inc., Costa Mesa, Calif.
28520	Hayman Mfg. Co., Kenilworth, N. J.
28959	Hoffman Electronics Corp., El Monte, Calif.
30874	International Business Machines, Armonk, N.Y.
32001	Jensen Mfg. Co., Chicago, Ill. 60638
35929	Constanta Co. of Canada Limited, Montreal 19, Quebec
37942	P. R. Mallory and Co. Inc., Indianapolis, Ind.
38443	Marlin-Rockwell Corp., Jamestown, N. Y.
40931	Honeywell Inc., Minneapolis, Minn. 55408
42190	Muter Co., Chicago, Ill. 60638
42498	National Co. Inc., Melrose, Mass. 02176
43991	Norma-Hoffman Bearings Corp., Stanford, Conn. 06904
49671	RCA, New York, N. Y.
49956	Raytheon Mfg. Co., Waltham, Mass. 02154
53021	Sangamo Electric Co., Sprungfield, Ill. 62705
54294	Shallcross Mfg. Co., Selma, N. C.
54715	Shure Brothers, Inc., Evanston, Ill.
56289	Sprague Electric Co., N. Adams, Mass.
59730	Thomas and Betts Co., Elizabeth, N. J. 07207
59875	TRW Inc. (Accessories Div), Cleveland, Ohio
60399	Torrington Mfg. Co., Torrington, Conn.
61637	Union Carbide Corp., New York, N. Y. 10017
61864	United-Carr Fastener Corp., Boston, Mass.
63060	Victoreen Instrument Co., Inc., Cleveland, Ohio
63743	Ward Leonard Electric Co., Mt. Vernon, N. Y.
65083	Westinghouse (Lamp Div), Bloomfield, N. J.
65092	Weston Instruments, Weston-Newark, Newark, N. J.
70485	Atlantic-India Rubber Works, Inc., Chicago, Ill. 60607
70563	Amperite Co., Union City, N. J. 07087
70903	Belden Mfg. Co., Chicago, Ill. 60644
71126	Bronson, Homer D., Co., Beacon Falls, Conn.
71294	Canfield, H. O. Co., Clifton Forge, Va. 24422
71400	Bussman Mfg. Div. of McGraw Edison Co., St. Louis, Mo.
71590	Centralab, Inc., Milwaukee, Wisc. 53212
71666	Continental Carbon Co., Inc., New York, N. Y.
71707	Coto Coil Co. Inc., Providence, R. I.
71744	Chicago Minature Lamp Works, Chicago, Ill.
71785	Cinch Mfg. Co. and Howard B. Jones Div., Chicago, Ill. 60624
71823	Darnell Corp., Ltd., Downey, Calif. 90241
72136	Electro Motive Mfg. Co., Willmington, Conn.
72259	Nytronics Inc., Berkeley Heights, N. J. 07922
72619	Dialight Co., Brooklyn, N. Y. 11237
72699	General Instrument Corp., Capacitor Div., Newark, N. J. 07104
72765	Drake Mfg. Co., Chicago, Ill. 60656
72825	Hugh H. Eby, Inc., Philadelphia, Penn. 19144
72962	Elastic Stop Nut Corp., Union, N. J. 07083
72982	Erie Technological Products Inc., Erie, Penn.
73138	Beckman, Inc., Fullerton, Calif. 92634
73445	Amperex Electronics Co., Hicksville, N. Y.
73559	Carling Electric Co., W. Hartford, Conn.
73690	Elco Resistor Co., New York, N. Y.
73899	J. F. D. Electronics Corp., Brooklyn, N. Y.
74193	Heinemann Electric Co., Trenton, N. J.
74861	Industrial Condenser Corp., Chicago, Ill.
74970	E. F. Johnson Co., Waseca, Minn. 56093
75042	IRC Inc., Philadelphia, Penn. 19108
75382	Kulka Electric Corp., Mt. Vernon, N. Y.
75608	Linden and Co., Providence, R. I.
75915	Littelfuse, Inc., Des Plaines, Ill. 60016
76005	Lord Mfg. Co., Erie, Penn. 16512
76487	James Millen Mfg. Co., Malden, Mass. 02148
76545	Mueller Electric Co., Cleveland, Ohio 44114
76684	National Tube Co., Pittsburg, Penn.
76854	Oak Mfg. Co., Crystal Lake, Ill.
77147	Patton MacGuyer Co., Providence, R. I.
77166	Pass-Seymour, Syracuse, N. Y.
77263	Pierce Roberts Rubber Co., Trenton, N. J.
77339	Positive Lockwasher Co., Newark , N. J.
77542	Ray-O-Vac Co., Madison, Wisc.
77630	TRW, Electronic Component Div., Camden, N. J. 08103
77638	General Instruments Corp., Brooklyn, N. Y.
78189	Shakeproof Div. of Ill. Tool Works, Elgin, Ill. 60120
78277	Sigma Instruments Inc., S. Braintree, Mass.
78488	Stackpole Carbon Co., St. Marys, Penn.
78553	Tinnerman Products, Inc., Cleveland, Ohio
79089	RCA, Commercial Receiving Tube and Semi-conductor Div., Harrison, N. J.
79725	Wiremold Co., Hartford, Conn. 06110
79963	Zierick Mfg. Co., New Rochelle, N. Y.
80030	Prestole Fastener Div. Bishop and Babcock Corp., Toledo, Ohio
80048	Vickers Inc. Electric Prod. Div., St. Louis, Mo.
80131	Electronic Industries Assoc., Washington, D.C.
80211	Motorola Inc., Franklin Park, Ill. 60131
80258	Standard Oil Co., Lafeyette, Ind.
80294	Bourns Inc., Riverside, Calif. 92506
80431	Air Filter Corp., Milwaukee, Wisc. 53218
80583	Hammarlund Co. Inc., New York, N. Y.
80740	Beckman Instruments, Inc., Fullerton, Calif.
81073	Grayhill Inc., LaGrange, Ill. 60525
81143	Isolantite Mfg. Corp., Stirling, N. J. 07980
81349	Military Specifications
81350	Joint Army-Navy Specifications
81751	Columbus Electronics Corp., Yonkers, N. Y.
81831	Filton Co., Flushing, L. I., N. Y
81860	Barry Controls Div. of Barry Wright Corp., Watertown, Mass.
82219	Sylvania Electric Products, Inc., (Electronic Tube Div.), Emporium, Penn.
82273	Indiana Pattern and Model Works, LaPort, Ind.
82389	Switchcraft Inc., Chicago, Ill. 60630
82647	Metals and Controls Inc., Attleboro, Mass.
82807	Milwaukee Resistor Co., Milwaukee, Wisc.
83058	Carr Fastener Co., Cambridge, Mass.
83186	Victory Engineering Corp (IVECO), Sprungfield, N. J. 07081
83361	Bearing Specialty Co., San Francisco, Calif.
83587	Solar Electric Corp., Warren, Penn.
83740	Union Carbide Corp., New York, N. Y. 10017
84411	TRW Capacitor Div., Ogallala, Nebr.
84835	Lehigh Metal Products Corp., Cambridge, Mass. 02140
84971	TA Mfg. Corp., Los Angeles, Calif.
86577	Precision Metal Products of Malden Inc., Stoneham, Mass. 02180
86684	RCA (Electrical Component and Devices) Harrison, N. J.
88140	Cutler-Hammer Inc., Lincoln, Ill.
88219	Gould Nat. Batteries Inc., Trenton, N. J.
88419	Cornell Dubilier Electric Corp., Fuquay-Varina, N. C.
88627	K and G Mfg. Co., New York, N. Y.
89482	Holtzer Cabot Corp., Boston, Mass.
89665	United Transformer Co., Chicago, Ill.
90201	Mallory Capacitor Co., Indianapolis, Ind.
90750	Westinghouse Electric Corp., Boston, Mass.
90952	Hardware Products Co., Reading, Penn. 19602
91032	Continental Wire Corp., York, Penn. 17405
91140	ITT Cannon Electric Inc., Salem, Mass.
91293	Johanson Mfg. Co., Boonton, N. J. 07005
91598	Chandler Co., Wethersfield, Conn. 06109
91637	Dale Electronics Inc., Columbus, Nebr.
91662	Elco Corp., Willow Grove, Penn.
91719	General Instruments, Inc., Dallas, Texas
91929	Honeywell Inc., Freeport, Ill.
92519	Electra Insulation Corp., Woodside, Long Island, N. Y.
92678	Edgerton, Germeshausen and Grier, Boston, Mass.
93332	Sylvania Electric Products, Inc., Woburn, Mass.
93916	Cramer Products Co., New York, N. Y. 10013
94144	Raytheon Co. Components Div., Quincy, Mass.
94154	Tung Sol Electric Inc., Newark, N. J.
95076	Garde Mfg. Co., Cumberland, R. I.
95146	Alco Electronics Mfg. Co., Lawrence, Mass.
95238	Continental Connector Corp., Woodside, N. Y.
95275	Vitramon, Inc., Bridgeport, Conn.
95354	Methode Mfg. Co., Chicago, Ill.
95412	General Electric Co., Schenectady, N. Y.
95794	Ansconda American Brass Co., Torrington, Conn.
96095	Hi-Q Div. of Aerovox Corp., Orlean, N. Y.
96214	Texas Instruments Inc., Dallas, Texas 75209
96256	Thordarson-Meissner Div. of McGuire, Mt. Carmel, Ill.
96341	Microwave Associates Inc., Burlington, Mass.
96906	Military Standards
97966	CBS Electronics Div. of Columbia Broadcasting Systems, Danvers, Mass.
98291	Sealectro Corp., Mamaroneck. N. Y. 10544
98821	North Hills Electronics Inc., Glen Cove, N. Y.
99180	Transitron Electronics Corp., Melrose, Mass.
99378	Atlee Corp., Winchester, Mass. 01890
99800	Delevan Electronics Corp., E. Aurora, N. Y.

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PARTS LIST

Ref. Desig.	Description	GR Part No.	FMC	Mfg. Part No.	Fed. Stock No.
BATTERIES					
B501		8410-0410	24655	8410-0410	
CAPACITORS					
C101	Trimmer, 0.8 - 8.5 pF	4910-1101	24655	4910-1101	5910-911-8073
C102	Mica, 51.1 pF ±2% 100 V	4650-0102	72136	CM15E, 51.1 pF ±2%	
C103	Mica, 464 pF ±2% 300 V	4650-0546	72136	CM15E, 464 pF ±2%	
C104	Plastic, .0013 µF ±5% 100 V	4860-7349	84411	663UW, .0013 µF ±5%	
C105	Plastic, 0.0030 µF ±5% 200 V	4860-7349	84411	663 UW, 0.0030 µF ±5%	
C106	Mylar, .01 µF ±10% 100 V	4860-7750	84411	663 UW, .01 µF ±10%	5910-448-5778
C107	Electrolytic, 5 µF 5 V	4450-3900	37942	2040595S9C10X3	5910-448-5527
C110	Electrolytic, 40 µF 6 V	4450-3600	37942	20-40707S4	5910-952-0467
C111	Plastic, 0.36 µF ±5% 100 V	4860-7986	84411	663UW, 0.36 µF ±5%	
C112	Plastic, 0.18 µF ±5% 100 V	4860-7897	84411	663UW, 0.18 µF ±5%	
C113	Electrolytic, 40 µF 6 V	4450-3600	37942	20-40707S4	5910-952-0467
C114	Electrolytic, 10 µF 25 V	4450-3800	56289	30D106G025BB4M1	5910-952-8658
C115	Electrolytic, 40 µF 6 V	4450-3600	37942	20-40707S4	5910-952-0467
C116	Electrolytic, 100 µF 15 V	4450-2800	56289	D17872	5910-034-5368
C117	Mylar, .47 µF ±10% 100 V	4860-8248	84411	663 UW, .47 µF ±10%	
C201	Plastic, 0.0691 µF ±1% 100 V	4860-7879	84411	663UW, 0.0691 µF ±1%	
C202	Mylar, .017 µF ±1% 100 V	4860-7856	84411	663 UW, .017 µF ±1%	
C203	Plastic, 0.277 µF ±1% 100 V	4860-7952	84411	663UW, 0.277 µF ±1%	
C204	Plastic, 0.00414 µF ±1% 200 V	4860-7385	84411	663UW, 0.00414 µF ±1%	
C205	Plastic, 1.09 µF ±1% 100 V	4860-8010	84411	663UW, 1.09 µF ±1%	
C206	Plastic, 0.0691 µF ±1% 100 V	4860-7879	84411	663UW, 0.0691 µF ±1%	
C207	Plastic, 0.277 µF ±1% 100 V	4860-7952	84411	663UW, 0.277 µF ±1%	
C208	Plastic, 1.09 µF ±1% 100 V	4860-8010	84411	663UW, 1.09 µF ±1%	
C209	Plastic, 0.0170 µF 100 V	4860-7856	84411	663UW, 0.0170 µF	
C210	Plastic, 0.00414 µF ±1% 200 V	4860-7385	84411	663UW, 0.00414 µF	
C211	Electrolytic, 5 µF 50 V	4450-3900	37942	2040595S9C10X3	5910-448-5527
C213	Electrolytic, 40 µF 6 V	4450-3600	37942	20-40707S4	5910-952-0467
C214	Electrolytic, 100 µF 15 V	4450-2800	56289	D17872	5910-034-5368
C217	Plastic, 0.0383 µF ±1% 100 V	4860-7857	84411	663UW, 0.0383 µF ±1%	
C218	Mylar, .00947 µF ±1% 100 V	4860-7553	84411	663 UW, .00947 µF ±1%	
C219	Plastic, 0.153 µF ±1% 100 V	4860-7896	84411	663UW, 0.153 µF ±1%	
C220	Plastic, 0.608 µF ±1% 100 V	4860-7994	84411	663UW, 0.608 µF ±1%	
C221	Mylar, .0228 µF ±1%	4860-7328	84411	663 UW, .0228 µF ±1%	
C222	Plastic, 0.0383 µF ±1% 100 V	4860-7857	84411	663UW, 0.0383 µF ±1%	
C223	Plastic, 0.153 µF ±1% 100 V	4860-7896	84411	663UW, 0.153 µF ±1%	
C224	Plastic, 0.608 µF ±1% 100 V	4860-7994	84411	663UW, 0.608 µF ±1%	
C225	Plastic, 0.00947 µF ±1% 100 V	4860-7553	84411	663UW, 0.00947 µF ±1%	
C226	Plastic, 0.00228 µF ±1% 200 V	4860-7328	84411	663UW, 0.00228 µF ±1%	
C227	Electrolytic, 5 µF 50 V	4450-3900	37942	2040595S9C10X3	5910-448-5527
C229	Electrolytic, 100 µF 15 V	4450-2800	56289	D17872	5910-034-5368
C232	Electrolytic, 10 µF 25 V	4450-3800	56289	30D106G025BB4M1	5910-952-8658
C233	Electrolytic, 10 µF 25 V	4450-3800	56289	30D106G025BB4M1	5910-952-8658
C234	Plastic, 0.00323 µF ±1% 200 V	4860-7348	84411	663UW, 0.00323 µF ±1%	
C235	Plastic, 0.0129 µF ±1% 100 V	4860-7844	84411	663UW, 0.0129 µF ±1%	
C236	Plastic, 0.816 µF ±1% 100 V	4860-7996	84411	663UW, 0.816 µF ±1%	
C237	Plastic, 0.205 µF ±1% 100 V	4860-7925	84411	663UW, 0.205 µF ±1%	
C238	Plastic, 0.0514 µF ±1% 100 V	4860-7878	84411	663UW, 0.0514 µF ±1%	
C239	Plastic, 0.00310 µF ±1% 200 V	4860-7337	84411	663UW, 0.00310 µF ±1%	
C240	Plastic, 0.0127 µF ±1% 100 V	4860-7852	84411	663UW, 0.0127 µF ±1%	
C241	Plastic, 0.0514 µF ±1% 100 V	4860-7878	84411	663UW, 0.0514 µF ±1%	
C242	Plastic, 0.205 µF ±1% 100 V	4860-7925	84411	663UW, 0.205 µF ±1%	
C243	Plastic, 0.816 µF ±1% 100 V	4860-7996	84411	663UW, 0.816 µF ±1%	
C245	Electrolytic, 600 µF 3 V	4450-5589	37942	TCM, 600 µF 3V	
C246	Electrolytic, 10 µF 25 V	4450-3800	56289	30D106G025BB4M1	5910-952-8658
C247	Electrolytic, 40 µF 6 V	4450-3600	37942	20-40707S4	5910-952-0467
C248	Electrolytic, 100 µF 15 V	4450-2800	56289	D17872	5910-034-5368
C249	Electrolytic, 10 µF 25 V	4450-3800	56289	30D106G025BB4M1	5910-952-8658
C250	Electrolytic, 10 µF 25 V	4450-3800	56289	30D106G025BB4M1	5910-952-8658
C252	Mica, 82 pF ±5% 500 V	4640-0442	72136	CM15, 82 pF ±5%	
C301	Electrolytic, 40 µF 6 V	4450-3600	37942	20-40707S4	5910-952-0467
C302	Electrolytic, 100 µF 15 V	4450-2800	56289	D17872	5910-034-5368
C303	Electrolytic, 200 µF 6 V	4450-2610	37942	TT, 200 µF 6 V	5910-945-1836
C304	Electrolytic, 10 µF ±20% 20 V	4450-5100	56289	150D106X0020B2	5910-855-6343
C305	Electrolytic, 1.5 µF ±20% 20 V	4450-4400	56289	150D155X0020A2	5910-670-7525
C306	Electrolytic, 60 µF 25 V	4450-2900	56289	D17872	5910-799-9280
C307	Electrolytic, 10 µF ±20% 20 V	4450-5100	56289	150D106X0020B2	5910-855-6343
C308	Electrolytic, 10 µF ±20% 20 V	4450-5100	56289	150D106X0020B2	5910-855-6343
C309	Plastic, 0.0013 µF ±5% 200 V	4860-7315	84411	663UW, 0.0013 µF ±5%	
C310	Plastic, 0.0013 µF ±5% 200 V	4860-7315	84411	663UW, 0.0013 µF ±5%	
C311	Mica, 100 pF ±10% 500 V	4700-0400	14655	22A5T1, 100 pF ±10%	
C501	Electrolytic, 100 µF 25 V	4450-2300	76149	20-40595	5910-799-9284
C502	Electrolytic, 100 µF ±20% 20 V	4450-5704	56289	150D107X0020S3	
C503	Electrolytic, 100 µF 25 V	4450-2300	76149	20-40595	5910-799-9284

PARTS LIST (cont)

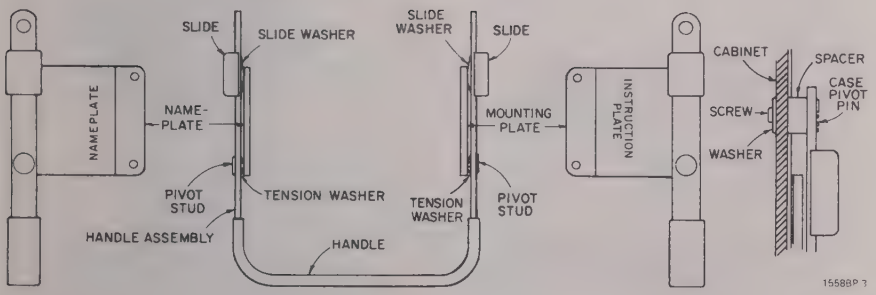
Ref. Desig.	Description	GR Part No.	FMC	Mfg. Part No.	Fed. Stock No.
CAPACITORS					
C504	Electrolytic, 100 µF 25 V	4450-2300	76149	20-40595	5910-799-9284
C701	Plastic, 0.045 µF ±1% 100 V	4860-8150	84411	663UW, 0.045 µF ±1%	
C702	Plastic, 0.036 µF ±5% 100 V	4860-7986	84411	663UW, 0.036 µF ±5%	
C703	Plastic, 0.0051 µF ±5% 100 V	4860-7499	84411	663UW, 0.0051 µF ±5%	
C704	Plastic, 0.30 µF ±5% 100 V	4860-7972	84411	663UW, 0.30 µF ±5%	
DIODES					
CR301	Type 1N34AS	6082-1003	58854	1N34A(S)	5961-170-4430
CR302	Type 1N34AS	6082-1003	58854	1N34A(S)	5961-170-4430
CR303	Type 1N34AS	6082-1003	58854	1N34A(S)	5961-170-4430
CR304	Type 1N34AS	6082-1003	58854	1N34A(S)	5961-170-4430
CR305	Type 1N3253	6081-1001	79089	1N3253	5961-814-4251
CR306	Type 1N3253	6081-1001	79089	1N3253	5961-814-4251
CR307	Type 1N645	6082-1016	24446	1N645	5961-944-8222
CR308	Type 1N645	6082-1016	24446	1N645	5961-944-8222
CR309	Type 1N645	6082-1016	24446	1N645	5961-944-8222
CR501	Type 1N3255	6081-1003	79089	1N3255	
JACKS					
J101		4260-1040	82389	112A	
J301		4260-1030	82389	111	
METER					
M301		5730-1050	40931	Meds 105	6625-708-5186
PLUG					
PL501		4220-4300	71785	P-302-AB	
RESISTORS					
R101	Composition, 75 kΩ ±5% 1/2 W	6100-3755	01121	RC20GF753J	5905-279-3495
R102	Composition, 100 kΩ ±5% 1/2 W	6100-4105	01121	RC20GF104J	5905-195-6761
R103	Composition, 5.1 MΩ ±5% 1/2 W	6100-5515	01121	RC20GF515J	
R104	Composition, 100 MΩ ±5% 1/4 W	6099-7105	75042	BTS, 100 MΩ ±5%	
R105	Composition, 110 kΩ ±5% 1/2 W	6100-4115	01121	RC20GF114J	5905-279-1867
R106	Potentiometer, Composition, 100 kΩ ±20%	6040-1000	01121	FWC, 100 kΩ ±20%	5905-958-7949
R107	Composition, 15 kΩ ±5% 1/2 W	6100-3155	01121	RC20GF153J	5905-279-2616
R108	Composition, 100 kΩ ±5% 1/2 W	6100-4105	01121	RC20GF104J	5905-195-6761
R109	Composition, 10 kΩ ±5% 1/2 W	6100-3105	01121	RC20GF103J	5905-185-8510
R110	Composition, 300 kΩ ±5% 1/2 W	6100-4305	01121	RC20GF304J	5905-185-6859
R111	Film, 20.5 kΩ ±1% 1/8 W	6250-2205	75042	CEA, 20.5 kΩ ±1%	5905-819-1262
R112	Film, 20.5 kΩ ±1% 1/8 W	6250-2205	75042	CEA, 20.5 kΩ ±1%	5905-819-1262
R113	Film, 30.1 kΩ ±1% 1/8 W	6250-2301	75042	CEA, 30.1 kΩ ±1%	5905-702-1760
R114	Film, 14.0 kΩ ±1% 1/8 W	6250-2140	75042	CEA, 14.0 kΩ ±1%	
R115	Film, 14.0 kΩ ±1% 1/8 W	6250-2140	75042	CEA, 14.0 kΩ ±1%	
R116	Composition, 18 kΩ ±5% 1/2 W	6100-3185	01121	RC20GF183J	5905-279-3500
R117	Composition, 33 kΩ ±5% 1/2 W	6100-3335	01121	RC20GF333J	5905-171-1998
R118	Composition, 10 kΩ ±5% 1/2 W	6100-3105	01121	RC20GF103J	5905-185-8510
R119	Composition, 7.5 kΩ ±5% 1/2 W	6100-2755	01121	RC20GF752J	5905-249-4195
R120	Composition, 2.7 kΩ ±5% 1/2 W	6100-2275	01121	RC20GF272J	5905-279-1880
R121	Composition, 430 Ω ±5% 1/2 W	6100-1435	01121	RC20GF431J	5905-279-3512
R122	Composition, 300 kΩ ±5% 1/2 W	6100-4305	01121	RC20GF304J	5905-185-6859
R123	Composition, 11 kΩ ±5% 1/2 W	6100-3115	01121	RC20GF113J	5905-279-2667
R124	Composition, 100 kΩ ±5% 1/2 W	6100-4105	01121	RC20GF104J	5905-195-6761
R125	Composition, 1.3 kΩ ±5% 1/2 W	6100-2135	01121	RC20GF132J	5905-279-1870
R126	Potentiometer, Composition, 10 kΩ ±10%	6030-0150	24655	6030-0150	
R127	Composition, 10 kΩ ±5% 1/2 W	6100-3105	01121	RC20GF103J	5905-185-8510
R128	Film, 5.62 MΩ ±1%	6450-4562	75042	CEC-TO, 5.62 MΩ ±1%	
R129	Film, 45.3 MΩ ±1% 1/2 W	6619-3404	75042	CEA-TO, 45.3 MΩ ±1%	
R201	Film, 8.87 kΩ ±1% 1/8 W	6250-1887	75042	CEA, 8.87 kΩ ±1%	5905-837-2911
R202	Wire wound, 6.19 kΩ ±0.25% 1/8 W	6981-4026	24655	6981-4026	
R203	Wire wound, 3.09 kΩ ±0.25% 1/8 W	6981-4021	24655	6981-4021	
R204	Wire wound, 4.53 kΩ ±0.25% 1/8 W	6981-4024	24655	6981-4024	
R205	Composition, 33 kΩ ±5% 1/2 W	6100-3335	01121	RC20GF333J	5905-171-1998
R206	Wire wound, 6.19 kΩ ±0.25% 1/8 W	6981-4026	24655	6981-4026	
R209	Wire wound, 9.65 kΩ ±0.25% 1/8 W	6981-4029	24655	6981-4029	
R210	Composition, 7.5 kΩ ±5% 1/2 W	6100-2755	01121	RC20GR752J	5905-249-4195
R211	Potentiometer, Composition, 1 kΩ ±20%	6040-0400	01121	FWC, 1 kΩ ±20%	
R212	Composition, 3 kΩ ±5% 1/2 W	6100-2305	01121	RC20GF302J	5905-279-1751
R213	Film, 8.66 kΩ ±1% 1/8 W	6250-1866	75042	CEA, 8.66 kΩ ±1%	5905-755-8130
R214	Film, 3.01 kΩ ±1% 1/8 W	6250-1301	75042	CEA, 3.01 kΩ ±1%	5905-702-5974
R217	Film, 8.87 kΩ ±1% 1/8 W	6250-1887	75042	CEA, 8.87 kΩ ±1%	5905-837-2911
R218	Wire wound, 6.19 kΩ ±0.25% 1/8 W	6981-4026	24655	6981-4026	
R219	Wire wound, 3.09 kΩ ±0.25% 1/8 W	6981-4021	24655	6981-4021	
R220	Wire wound, 4.35 kΩ ±0.25% 1/8 W	6981-4024	24655	6981-4024	
R222	Composition, 33 kΩ ±5% 1/2 W	6100-3335	01121	RC20GF333J	
R223	Wire wound, 6.19 kΩ ±0.25% 1/8 W	6981-4026	24655	6981-4026	
R225	Wire wound, 9.65 kΩ ±0.25% 1/8 W	6981-4029	24655	6981-4029	

PARTS LIST (cont)

	Description	GR Part No.	FMC	Mfg. Part No.	Fed. Stock No.
RESISTORS					
R226	Film, 11 kΩ ±1% 1/8 W	6250-2110	75042	CEA, 11 kΩ ±1%	
R227	Composition, 62 kΩ ±5% 1/2 W	6100-3625	01121	RC20GF623J	5905-249-3656
R228	Composition, 7.5 kΩ ±5% 1/2 W	6100-2755	01121	RC20GF752J	5905-249-4195
R229	Potentiometer, 1 kΩ ±20%	6040-0400	01121	FWC, 1 kΩ ±20%	
R230	Composition, 3 kΩ ±5% 1/2 W	6100-2305	01121	RC20GF302J	5905-279-1751
R231	Film, 8.66 kΩ ±1% 1/8 W	6250-1866	75042	CEA, 8.66 kΩ ±1%	5905-755-8130
R232	Film, 3.01 kΩ ±1% 1/8 W	6250-1301	75042	CEA, 3.01 kΩ ±1%	5905-702-5974
R235	Composition, 1.5 kΩ ±5% 1/2 W	6100-2155	01121	RC20GF152J	5905-841-7461
R236	Composition, 5.1 kΩ ±5% 1/2 W	6100-2515	01121	RC20GF512J	5905-279-2019
R238	Film, 14.3 kΩ ±1% 1/8 W	6250-2143	75042	CEA, 14.3 kΩ ±1%	5905-686-9983
R239	Wire wound, 3.09 kΩ ±0.25% 1/8 W	6981-4021	24655	6981-4021	
R240	Wire wound, 6.19 kΩ ±0.25% 1/8 W	6981-4026	24655	6981-4026	
R241	Film, 750 Ω ±1% 1/8 W	6250-0750	75042	CEA, 750 Ω ±1%	5905-676-8776
R242	Film, 3.16 kΩ ±1% 1/8 W	6250-1316	75042	CEA, 3.16 kΩ ±1%	5905-577-1792
R243	Composition, 110 kΩ ±5% 1/2 W	6100-4115	01121	RC20GF114J	5905-279-1867
R244	Film, 21.5 kΩ ±1% 1/8 W	6250-2215	75042	CEA, 21.5 kΩ ±1%	5905-615-7339
R245	Film, 3.16 kΩ ±1% 1/8 W	6250-1316	75042	CEA, 3.16 kΩ ±1%	5905-577-1792
R246	Film, 29.4 kΩ ±0.25% 1/8 W	6190-7200	75042	M9A-TO, 29.4 kΩ ±0.25%	
R247	Composition, 8.2 kΩ ±5% 1/2 W	6100-2825	01121	RC20GF822J	5905-299-1971
R248	Wire wound, 3 kΩ ±0.25% 1/8 W	6981-4023	24655	6981-4023	
R249	Composition, 33 kΩ ±5% 1/2 W	6100-3335	01121	RC20GF333J	5905-171-1998
R250	Wire wound, 6.19 kΩ ±0.25% 1/8 W	6981-4026	24655	6981-4026	
R251	Film, 10.5 kΩ ±1% 1/8 W	6250-2105	75042	CEA, 10.5 kΩ ±1%	5905-882-0037
R252	Pot., 1 kΩ ±20%	6040-0400	01121	FWC, 1 kΩ ±20%	
R253	Composition, 2.4 kΩ ±5% 1/2 W	6100-2245	01121	RC20GF242J	5905-279-1877
R254	Film, 665 Ω ±1% 1/8 W	6250-0665	75042	CEA, 665 Ω ±1%	
R255	Composition, 13 kΩ ±5% 1/2 W	6100-3135	01121	RC20GF133J	5905-279-2669
R256	Composition, 300 Ω ±5% 1/2 W	6100-1305	01121	RC20GF301J	5905-279-5481
R257	Pot., 1 kΩ ±20%	6040-0400	01121	FWC, 1 kΩ ±20%	
R258	Film, 124 Ω ±1% 1/8 W	6250-0124	75042	CEA, 124 Ω ±1%	5905-815-4136
R259	Film, 2.10 kΩ ±1% 1/8 W	6250-1210	75042	CEA, 2.10 kΩ ±1%	
R260	Composition, 1.5 kΩ ±5% 1/2 W	6100-2155	01121	RC20GF152J	5905-841-7461
R261	Composition, 5.1 kΩ ±5% 1/2 W	6100-2515	01121	RC20GF512J	5905-279-2019
R262	Composition, 62 kΩ ±5% 1/2 W	6100-3625	01121	RC20GR623J	5905-249-3656
R263	Film, 11 kΩ ±1% 1/8 W	6250-2110	75042	CEA, 11 kΩ ±1%	
R264	Composition, 110 kΩ ±5% 1/2 W	6100-4115	01121	RC20GF114J	5905-279-1867
R265	Film, 22.1 kΩ ±1% 1/8 W	6250-2221	75042	CEA, 22.1 kΩ ±1%	5905-702-5973
R301	Composition, 22 kΩ ±5% 1/2 W	6100-3225	01121	RC20GF223J	5905-171-2004
R302	Composition, 30 kΩ ±5% 1/2 W	6100-3305	01121	RC20GF303J	5905-192-3978
R303	Composition, 27 kΩ ±5% 1/2 W	6100-3275	01121	RC20GF273J	5905-279-3499
R304	Composition, 5.1 kΩ ±5% 1/2 W	6100-2515	01121	RC20GF512J	5905-279-2019
R305	Composition, 2 kΩ ±5% 1/2 W	6100-2205	01121	RC20GF202J	5905-190-8887
R306	Composition, 8.2 kΩ ±5% 1/2 W	6100-2825	01121	RC20GF822J	5905-299-1971
R307	Composition, 260 Ω ±5% 1/2 W	6100-1275	01121	RC20GF271J	5905-171-2006
R308	Composition, 8.2 kΩ ±5% 1/2 W	6100-2825	01121	RC20GF822J	5905-299-1971
R309	Composition, 6.2 kΩ ±5% 1/2 W	6100-2625	01121	RC20GF622J	5905-279-2673
R310	Composition, 300 kΩ ±5% 1/2 W	6100-4305	01121	RC20GF304J	5905-185-6859
R311	Composition, 2 kΩ ±5% 1/2 W	6100-2205	01121	RC20GF202J	5905-190-8887
R312	Composition, 11 kΩ ±5% 1/2 W	6100-3115	01121	RC20GF113J	5905-279-2667
R313	Composition, 680 Ω ±5% 1/2 W	6100-1685	01121	RC20GF681J	5905-195-6791
R314	Composition, 6.2 kΩ ±5% 1/2 W	6100-2625	01121	RC20GF622J	5905-279-2673
R315	Composition, 6.2 kΩ ±5% 1/2 W	6100-2625	01121	RC20GF622J	5905-279-2673
R316	Composition, 820 Ω ±5% 1/2 W	6100-1825	01121	RC20GF821J	5905-171-1999
R317	Composition, 1 MΩ ±5% 1/2 W	6100-5105	01121	RC20GF105J	5905-192-0390
R318	Film, 20 kΩ ±1% 1/8 W	6250-2200	75042	CEA, 20 kΩ ±1%	5905-702-5971
R319	Film, 147 kΩ ±1% 1/8 W	6250-3147	75042	CEA, 147 kΩ ±1%	5905-892-6965
R320	Film, 47.5 kΩ ±1% 1/8 W	6250-2475	75042	CEA, 47.5 kΩ ±1%	5905-577-6747
R321	Potentiometer, Composition, 25 kΩ ±20%	6040-0800	01121	FWC, 25 kΩ ±20%	5905-958-7950
R322	Potentiometer, 10 kΩ	0971-4220	24655	0971-4220	
R323	Film, 3.01 kΩ ±1% 1/8 W	6250-1301	75042	CEA, 3.01 kΩ ±1%	5905-702-5974
R324	Film, 100 kΩ ±1% 1/8 W	6250-3100	75042	CEA, 100 kΩ ±1%	5905-577-6743
R325	Film, 100 kΩ ±1% 1/8 W	6250-3100	75042	CEA, 100 kΩ ±1%	5905-577-6743
R501	Composition, 1 kΩ ±5% 1/2 W	6100-2105	01121	RC20GF102J	5905-195-6806
R502	Composition, 6.2 kΩ ±5% 1/2 W	6100-2625	01121	RC20GF622J	5905-279-2673
R503	Composition, 68 kΩ ±5% 1/2 W	6100-3685	01121	RC20GF683J	5905-249-3661
R504	Composition, 3 kΩ ±5% 1/2 W	6100-2305	01121	RC20GF302J	5905-279-1751
R505	Composition, 36 kΩ ±5% 1/2 W	6100-3365	01121	RC20GF363J	5905-249-4256
R506	Composition, 3 kΩ ±5% 1/2 W	6100-2305	01121	RC20GF302J	5905-279-1751
R507	Composition, 36 kΩ ±5% 1/2 W	6100-3365	01121	RC20GF363J	5905-249-4256
R508	Power, 1.2 kΩ ±5% 5 W	6660-2125	75042	AS-5, 1.2 kΩ ±5%	
R509	Power, 910 Ω ±5% 5 W	6660-1915	75042	AS-5, 910 Ω ±5%	
R510	Film, 34.8 kΩ ±1% 1/8 W	6250-2348	75042	CEA, 34.8 kΩ ±1%	5905-892-6968
R511	Film, 3.01 kΩ ±1% 1/8 W	6250-1301	75042	CEA, 3.01 kΩ ±1%	5905-702-5974
R701	Composition, 10 kΩ ±5%	6100-3105	01121	RC20GF103J	5905-185-8510

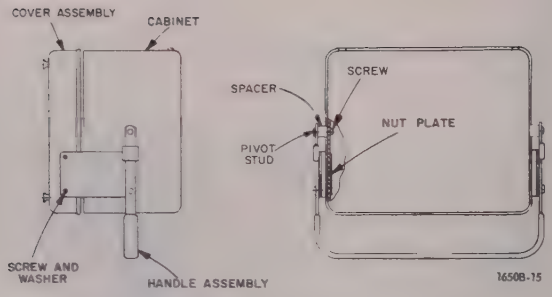
PARTS LIST (cont)

Ref. Desig.	Description	GR Part No.	FMC	Mfg. Part No.	Fed. Stock No.
SWITCHES					
S101		7890-2470	24655	7890-2470	
S102		7890-2500	24655	7890-2500	
S103		7890-2480	24655	7890-2480	
S201		7890-2490	24655	7890-2490	
S202		7890-2470	24655	7890-2470	
SOCKET					
SO101		4230-2850	24655	4230-2850	
TRANSISTORS					
Q101	Type C6601	8210-1032	12498	C6601	
Q102	Type 2N520A	8210-5200	72699	2N520A	
Q103 through Q105	Type 2N445A	8210-4451	93916	2N445A	5960-828-0776
Q201 through Q208	Type 2N445A	8210-4451	93916	2N445A	5960-828-0776
Q301 through Q303	Type 2N445A	8210-4451	93916	2N445A	5960-828-0776
Q304	Type 2N1374	8210-1374	96214	2N1374	
Q305	Type 2N1374	8210-1374	96214	2N1374	
Q501 through Q503	Type 2N445A	8210-4451	93916	2N445A	5960-828-0776



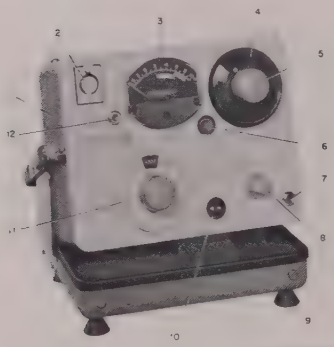
HANDLE AND BRACKET ASSEMBLY (1558-2201)

NAME	GR PART NO.	NAME	GR PART NO.
NAMEPLATE	7864-8031	MOUNTING PLATE	7860-3847
SLIDE	4170-1271	SCREW	7080-0700
PIVOT STUD	4170-1200	WASHER	8050-1500
HANDLE	5360-0799	CASE PIVOT PIN	4170-1267
SLIDE WASHER	4170-8010	SPACER	4170-0900
TENSION WASHER	4170-8501	CABINET	1558-1200



NAME	GR PART NO.	NAME	GR PART NO.
CABINET	1558-1200	COVER ASM.	1558-1211
SPACER	4170-0900	NUT PLATE	4170-1375
PIVOT STUD	4170-1050	SCREW	7080-1000
SCREW*	7080-0800	WASHER	8040-2400
HANDLE & BRACKET ASM.	1558-2201		

*Tighten 1/4-28 screws to 45-55 in. lbs. torque.
Bend mounting plate to give 1/32 to 1/16 spacing, both sides.



MECHANICAL PARTS LIST

Qnt	Fig Ref	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1	1	Cabinet asm. flip tilt includes	1558-3201	24655		1558-3201
1		Cabinet asm.	1558-1200	24655		1558-1200
1		Cover asm.	1558-1211	24655		1558-1211
1		Gasket for cover	5167-6310	24655		5167-6310
1	2	Socket, S0101, MICROPHONE	4230-2850	24655		4230-2850
1	3	Meter cover	5720-3712	24655		5720-3712
1	4	Dial asm., BAND LEVEL	1558-1010	24655		1558-1010
2	5	Knob asm., BAND LEVEL; BAND Hz, including retainer 5220-5401	5520-5420	24655		5520-5420
1	6	Knob asm., CAL	5540-2500	24655		5540-2500
1	7	Connector, J301, OUTPUT	4260-1030	82389		#111
1	8	Knob asm. METER, includes retainer 5220-5402	5500-5321	24655		5500-5321
4	9	Foot	5260-0760	24655		5260-0760
1	10	Plug, PL501	4220-4300	71785		P-302-B
1	11	Dial asm., BAND Hz	1558-1041	24655		1558-1041
1	12	Connector, J101, INPUT (SLM)	4260-1040	82389		112A

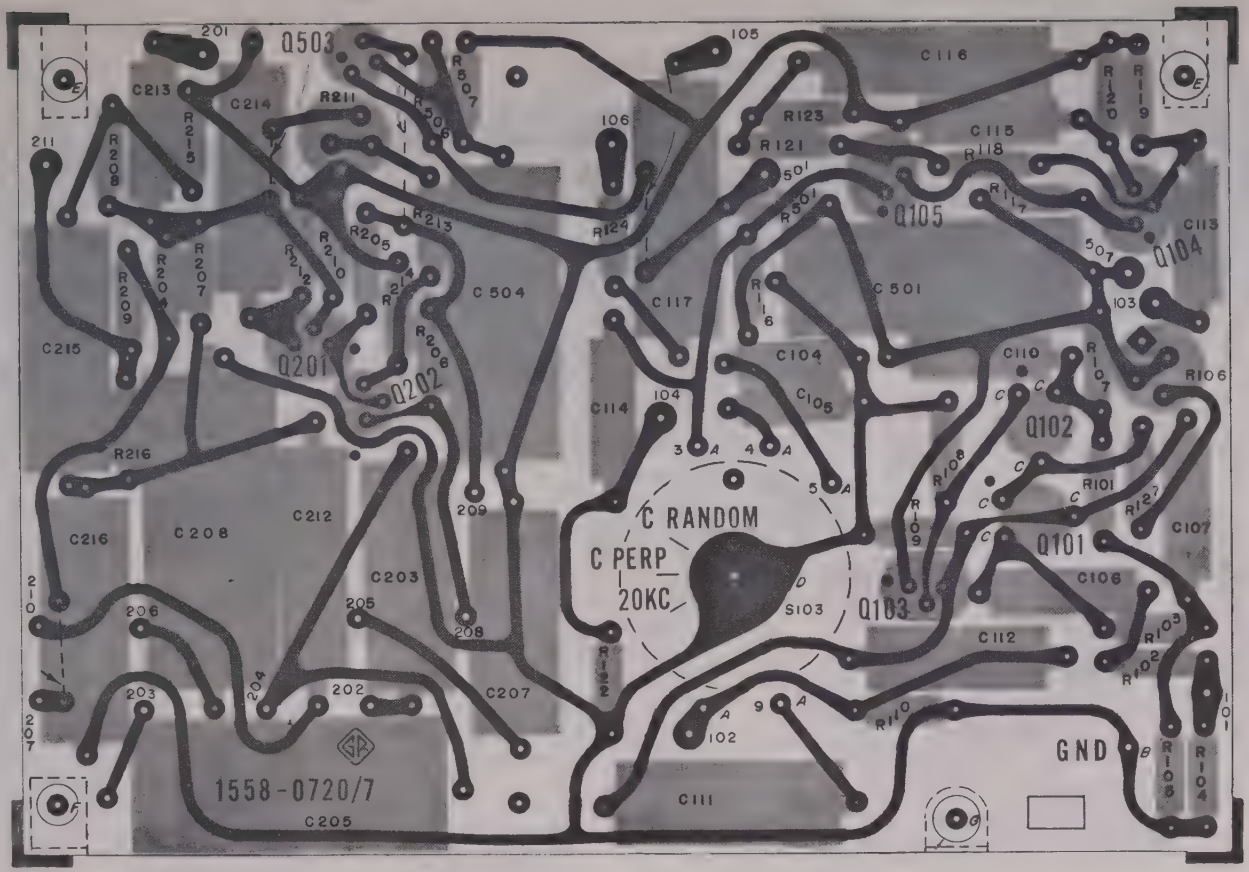


Figure 4-3. Preamplifier and first filter section etched board. Complete board is P/N 1558-2723.

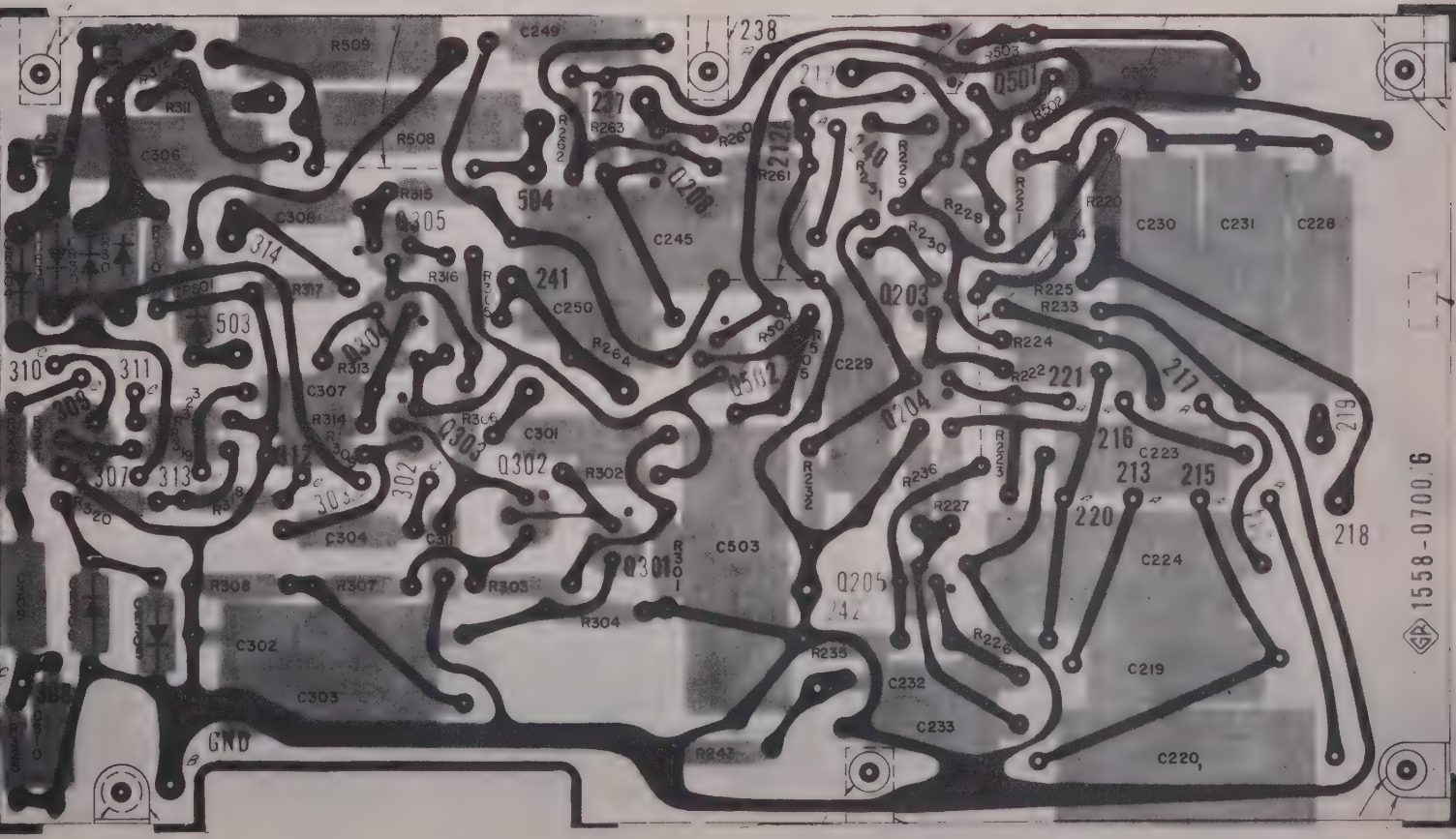


Figure 4-4. Second filter section and output amplifier etched board. Complete board is P/N 1558-2703.

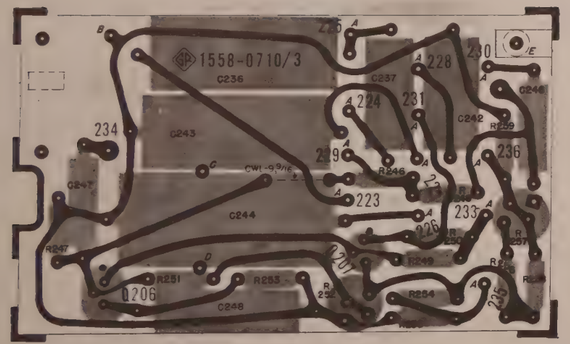


Figure 4-5. Third filter section etched board.
For Type 1558-BP omit C244.
Complete board is P/N 1558-2713.

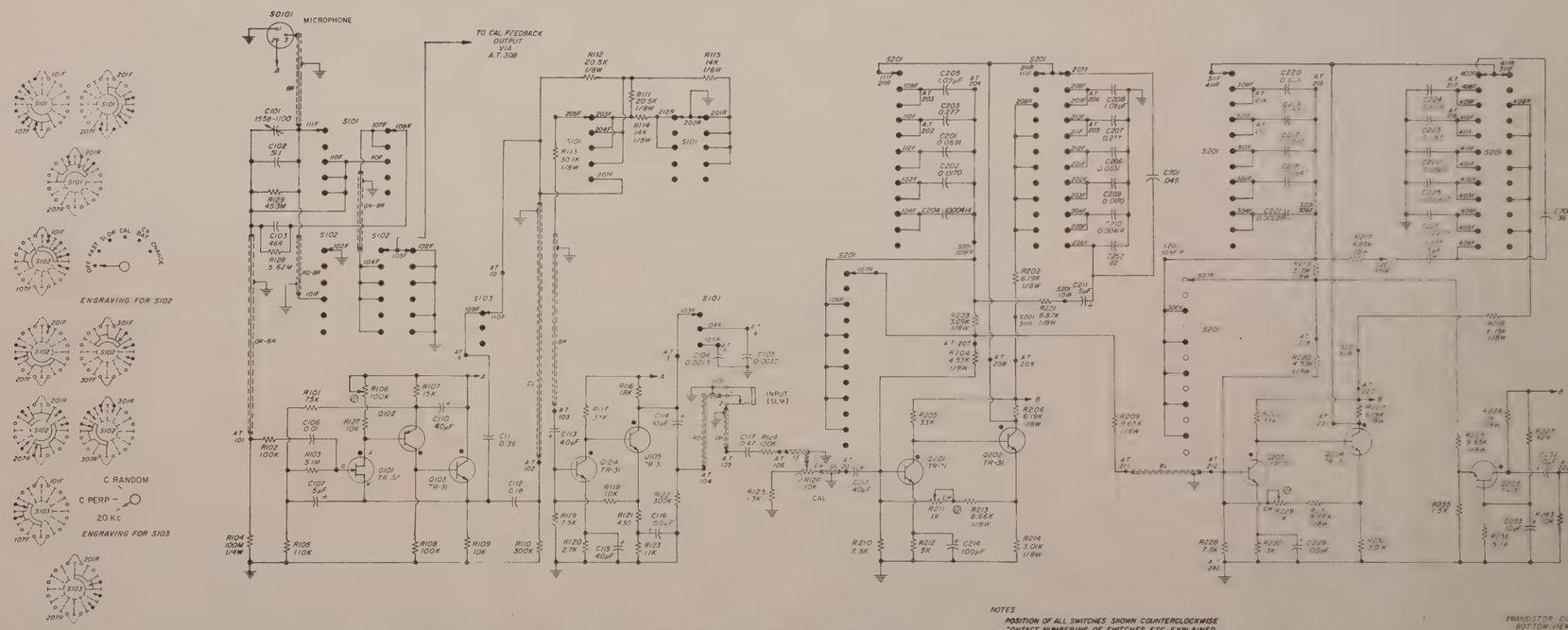
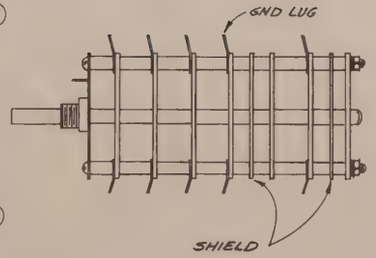
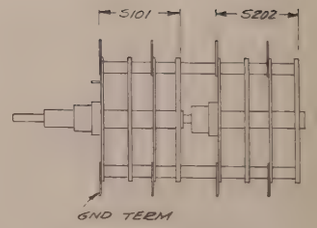


Figure 4-6. Schematic diagram for Type 1558-BP Octave Band Noise Analyzer (see Figure 4-7).

Rotary switch sections are shown as viewed from the panel end of the shaft. The first digit of the contact number refers to the section. The section nearest the panel is 1, the next section back is 2, etc. The next two digits refer to the contact. Contact 01 is the first position clockwise from a strut screw (usually the screw above the locating key), and the other contacts are numbered sequentially (02, 03, 04, etc), proceeding clockwise around the section. A suffix F or R indicates that the contact is on the front or rear of the section, respectively.



Switch Assembly (S201)



Switch Assembly (S101/S202).

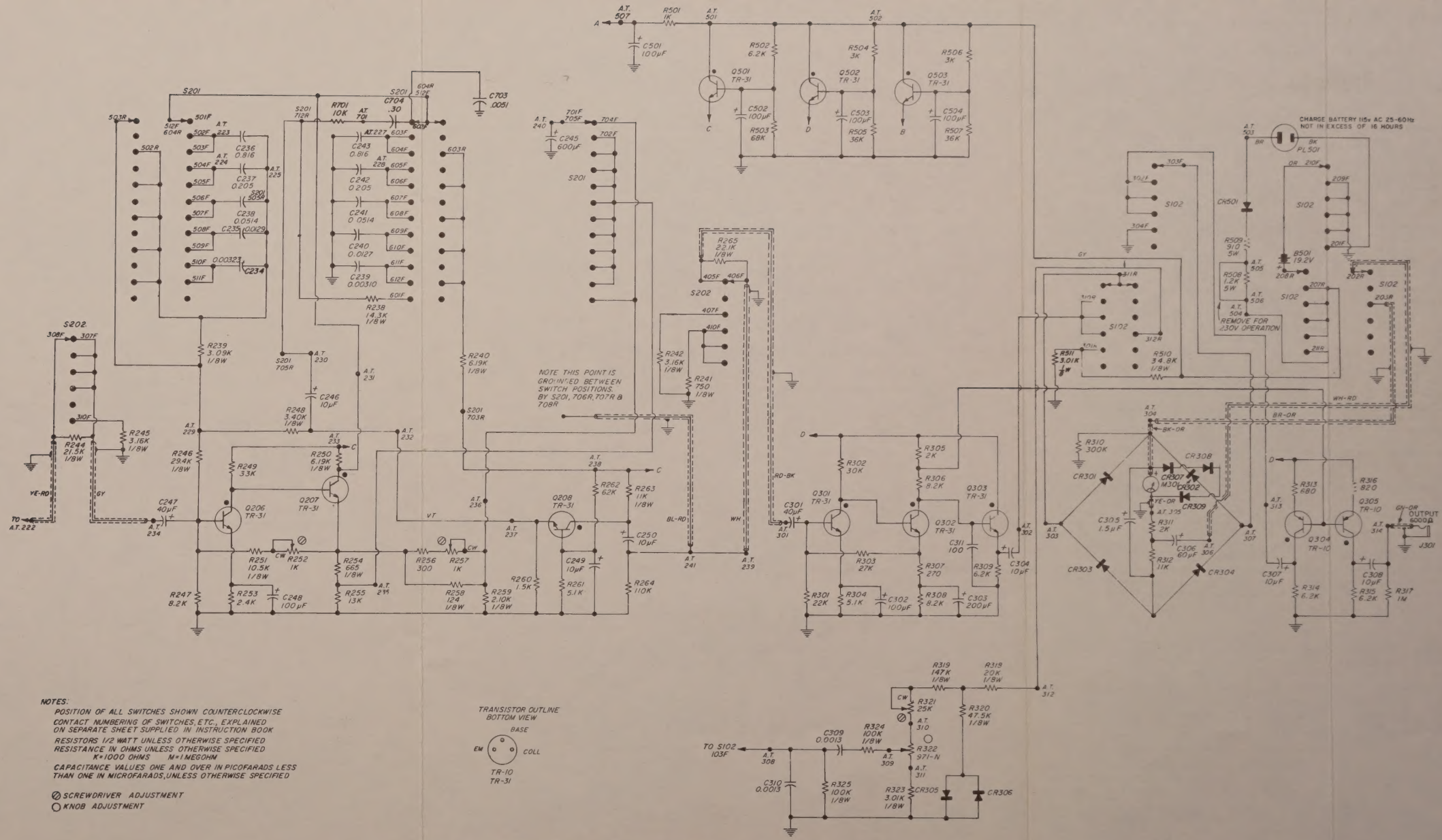


Figure 4-7. Schematic diagram for Type 1558-BP Octave Band Noise Analyzer (see Figure 4-6).

Appendix

VIBRATION MEASUREMENTS WITH THE TYPE 1558 OCTAVE BAND ANALYZER

Any General Radio vibration pickup can be used directly with the 1558 Analyzer. The meter on the analyzer reads in dB. Therefore, if we convert the meter reading to volts (or millivolts), we can obtain the acceleration, since the sensitivity of the pickup is given in volts/g.

To make the conversion, use the calibration procedure of paragraphs 3.2 and 3.3. Set the internal microphone-sensitivity control at -63.2 for the 1560-P52 Pickup and at -63.8 for the 1560-P53 or -P54 Pickup.

Then 70 mV = 107 dB
or 700 mV = 127 dB

The acceleration is given by

$$\text{Acceleration (in g)} = \frac{\text{Meter Reading (converted to volts)}}{\text{Sensitivity of the Pickup (in volts/g)}}$$

The velocity and displacement can then be computed from the acceleration and the frequency.

$$\text{Velocity} = \frac{\text{Acceleration}}{2\pi f}$$

$$\text{Displacement} = \frac{\text{Acceleration}}{4\pi^2 f^2}$$

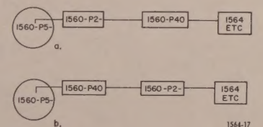
The high-frequency response will be determined by the resonant frequency of the pickup. The useful frequency ranges for the various pickups are given in the accompanying table.

PICKUP TYPE NO.	NOMINAL SENSITIVITY (mV/g)	NOMINAL IMPEDANCE (pF)	RESONANT FREQUENCY (fo)	USEFUL FREQUENCY RANGE WITH 1558 ANALYZER (Hz)
1560-P52	70	10,000	3200	20-1100
1560-P53	70	350	27,000	20-10,000
1560-P54	700	700	5000	20-1700

If the 1560-P40 Preamplifier is used between the pickup and the analyzer, the effective sensitivity can be increased 10 to 1. The low-frequency limit remains at 20 Hz, the low-frequency cutoff of the 1558.

If one wishes to use the control box to determine the velocity and displacement, the low-frequency limit in all cases is 25 Hz. The 1560-P40 Preamplifier can be used to increase the effective sensitivity, but it will not improve the low-frequency response appreciably, because this is limited by the control box. The connections and modifications necessary for the use of the preamplifier with the control box are given below.

The 1560-P40 Preamplifier can be used with the 1560-P2- Control Boxes with no modification if the connections are made as shown in a.



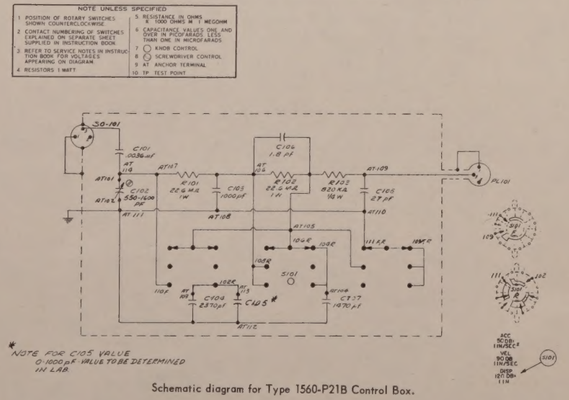
When the control box follows the preamplifier, as in b, the following modifications must be made: A connection must be provided to supply power for the 1560-P40 Preamplifier, and the output of the preamplifier must be made to look like the 1560-P5- pickup.

To provide the connection for power to the 1560-P40 preamplifier, replace the 1560-P2- output cable with a similar cable made from 2-wire shielded microphone cable (instead of single-conductor shielded (coax) cable). Use one of the two conductors to replace the single conductor of the original cable and connect the other from pin #2 of the OUTPUT plug to pin #2 of the INPUT socket of the 1560-P2- Control Box.

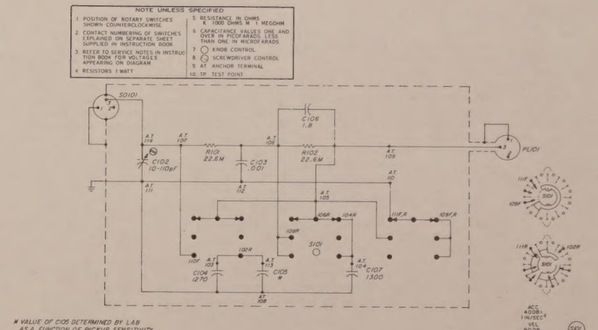
To provide the proper source impedance for the 1560-P2- Control Box, connect a capacitor in series with the input lead of the box. This capacitor must be equal to the capacitance of the appropriate vibration pickup plus its cable. Nominal values and the connection points for the three GR Vibration Systems are tabulated below. For best results, the measured value of the pickup capacitance including its connecting cable should be used.

VIB. MEAS. SYSTEM	CONTROL BOX	PICKUP	NOMINAL PICKUP CAP INC. CABLE	CONNECTION
1560-P11B	1560-P21B	1560-P52	.91 μF	IN SERIES WITH C101
1560-P13	1560-P23	1560-P53	525 pF	S0-101 #3 - AT 114
1560-P14	1560-P24	1560-P54	930 pF	S0-101 #3 - AT 114
1560-P11B	1560-P21B	1560-P52	.00265 μF*	S0-101 #3 - AT 114

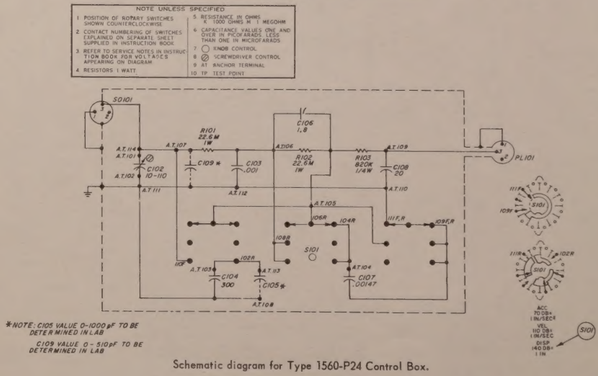
*Series combination of .01 μF and .0036 μF so C101 can be replaced with .00265 μF.


NOTE UNLESS SPECIFIED
1 POSITION OF ROTARY SWITCHES SHOWN COUNTERCLOCKWISE
2 CONTACT NUMBERING OF SWITCHES EXPLAINED ON SEPARATE SHEET SUPPLIED IN INSTRUCTION BOOK
3 REFER TO SERVICE NOTES IN INSTRUCTION BOOK FOR VOLTAGES APPEARING ON DIAGRAM
4 RESISTORS 1 WATT
5 RESISTANCE IN OHMS K = 1000 OHMS M = 1 MEGOHM
6 CAPACITANCE VALUES ONE AND OVER IN MICROFARADS, LESS THAN ONE IN MICROFARADS
7 KNOB CONTROL
8 SCREWDRIVER CONTROL
9 AT ANCHOR TERMINAL
10 TP TEST POINT
S0-101
C101 .0036 μF
AT 114
AT 107
AT 106
AT 111
C102 .550-700 pF
R101 22.6 MΩ 1W
C103 .0001 μF
C106 1.8 pF
R102 820 KΩ 1W
C105 .1000 pF
C105 27 pF
AT 109
AT 110
AT 108
AT 105
AT 104
AT 103
AT 102
C104 .270 μF
C105 #
C107 .1370 μF
P101
J101
* NOTE FOR C105 VALUE 0-1000 pF VALUE TO BE DETERMINED IN LAB.

Schematic diagram for Type 1560-P21B Control Box.


NOTE UNLESS SPECIFIED
1 POSITION OF ROTARY SWITCHES SHOWN COUNTERCLOCKWISE
2 CONTACT NUMBERING OF SWITCHES EXPLAINED ON SEPARATE SHEET SUPPLIED IN INSTRUCTION BOOK
3 REFER TO SERVICE NOTES IN INSTRUCTION BOOK FOR VOLTAGES APPEARING ON DIAGRAM
4 RESISTORS 1 WATT
5 RESISTANCE IN OHMS K = 1000 OHMS M = 1 MEGOHM
6 CAPACITANCE VALUES ONE AND OVER IN MICROFARADS, LESS THAN ONE IN MICROFARADS
7 KNOB CONTROL
8 SCREWDRIVER CONTROL
9 AT ANCHOR TERMINAL
10 TP TEST POINT
S0101
C106 1.8
C102 10-110pF
R101 22.6M
C103 .0101
R102 22.6M
AT 109
AT 111
AT 112
AT 105
AT 104
AT 103
C104 470
C105 #
C107 1300
P101
J101
VALUE OF C105 DETERMINED BY LAB AS A FUNCTION OF PICKUP SENSITIVITY

Schematic diagram for Type 1560-P23 Control Box.


NOTE UNLESS SPECIFIED
1 POSITION OF ROTARY SWITCHES SHOWN COUNTERCLOCKWISE
2 CONTACT NUMBERING OF SWITCHES EXPLAINED ON SEPARATE SHEET SUPPLIED IN INSTRUCTION BOOK
3 REFER TO SERVICE NOTES IN INSTRUCTION BOOK FOR VOLTAGES APPEARING ON DIAGRAM
4 RESISTORS 1 WATT
5 RESISTANCE IN OHMS K = 1000 OHMS M = 1 MEGOHM
6 CAPACITANCE VALUES ONE AND OVER IN MICROFARADS, LESS THAN ONE IN MICROFARADS
7 KNOB CONTROL
8 SCREWDRIVER CONTROL
9 AT ANCHOR TERMINAL
10 TP TEST POINT
S0101
C102 10-110
R101 22.6M
C103 .0001
C106 1.8
R102 22.6M 1W
R103 820K 1/4W
C108 50
C109 #
C105 #
P101
J101
*NOTE: C105 VALUE 0-1000 pF TO BE DETERMINED IN LAB
C109 VALUE 0-50 pF TO BE DETERMINED IN LAB

Schematic diagram for Type 1560-P24 Control Box.

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